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## A Monthly Popular Journal of Knowledge

Vol. X. No 116. AUGUST, 1929. PRICE 1s. NET

HER FIRST NEST IN ENGLAND
(See page 250)

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## Editorial Notes.

In announcing the schemes proposed by the new Government to alleviate unemployment, Mr. J. H. Thomas said that surveys preliminary to an increase of Empire cotton growing would be carried out by aeroplane in Africa. From time to time we have noted the progress made by this new method of research, which is slowly finding uses of economic value as well as in archaeology. Recently Mr. O. G. S. Crawford announced his intention of making an air survey in the Near East, and now a strong plea for such work in this area has been advanced by Sir Aurel Stein. Speaking last month at a dinner of the Central Asian Society, he said that in travelling through Mesopotamia he had observed remains, such as ancient roads and border posts, which were of special interest in connexion with the Roman occupation of Asia Minor. Already the French Air Force and the Service Géographique were surveying the French mandated area in northern Palestine, and much value would result from similar work in the south across the Jordan. There, too, must once have been a desert border guarded by Roman troops, and at the present time the Royal Air Force was still engaged in warding off nomad raids, as their predecessors had done. Sir Aurel Stein suggested that in addition to such police work the men should be utilized also for tracing the remains of these early Roman stations and routes of communication. In another frontier region, the North-West of India, Sir Aurel has himself made discoveries of the first importance regarding the Emperor Alexander, and his new book on the subject is reviewed on another page.

* * * * *

That the world grows smaller every day is a commonplace saying, but few people realize how true it continues to be. In an era of new triumphs over distance and time most of us take for granted the progress achieved, having become already accustomed to its almost monotonous occurrence. Everyone who considers the question will, of course, admit that such events as the latest flight from Australia to England in the remarkably short space of thirteen days are distinct steps forward towards linking up the corners of the world. On the other hand, the public has ceased to wonder at each new flying record, the stage having been reached when a considerable improvement is necessary to rouse enthusiasm. No less than aviation, wireless also is arriving at the point where its glamour is lessened by familiarity. New railway records too, once the delight of many besides the schoolboy enthusiast, have almost ceased to attract any attention at all. For example, what is believed to have been the fastest speed ever made by a train was attained only a few weeks ago on the Great Western Railway, between Cheltenham and London, yet the event received no more than a few lines notice in the newspapers.

* * * * *

In contrast to this new familiarity with transport and indifference to its progress, there is an almost universal ignorance of another field of endeavour, in which the international aspects are no less significant. We refer to such advances as the new convention on the Safety of Life at Sea, with which Colonel Crawley deals this month in our columns. It is one thing to discover some new appliance for improving the safety of travel and quite another to get it accepted by a responsible majority of nations, who agree to instal it in their ships. This, however, is the achievement of the International Conference which met in London last spring and of which the report has just been published. That responsible navigators from all the principal countries should co-operate more thoroughly than ever before in a code regarding safety procedure—

to which wireless has attributed so much since the previous conference was held on the eve of the war—is of quite as much importance as the discovery of the safety inventions themselves. Our increased mastery over Nature may in some spheres of research be a source of danger to peace, if applied in a selfish or nationalistic spirit; on the other hand, the world becomes smaller in the most desirable sense when its constituent parts co-operate in a joint attack on common dangers in travel or as regards health.

* * * * *

The proposals for reform of the British Patent system, recently advanced by the British Science Guild and reviewed in these columns, have now been examined by a committee of the Bar Council. The proposals were formulated under the chairmanship of Dr. W. H. Eccles, F.R.S., and another committee has since been appointed by the Board of Trade to consider the same subject. One of the most important comments made by the Bar Council deals with the question of publication. In their view a patent ought not to be invalidated by mere "paper" anticipations, that is, by the publication many years ago of ideas which came to naught and have never become known to the trade concerned. We have not seen the Bar report itself, but a difficulty which this interpretation at once suggests, is how it may be known whether a particular patent came to naught at the outset, or whether the inventor is still pursuing it in obscurity. In the latter event, it would bear hardly upon an inventor who, having put his idea into print as a preliminary safeguard, has since been working steadily at its improvement. However that may be, everyone will agree with the Bar Council that there should be stronger remedies against unwarranted threats, by which persons wrongly claiming to possess patent rights may seek to prejudice rival manufacturers.

* * * * *

During the past year we have published at intervals some brief notes on the excavations which Mr. Leonard Woolley continues to carry out at Ur in Mesopotamia. It therefore seems appropriate to summarize briefly the main achievements of the period, as described by the excavator himself in a recent lecture to the Royal Institution. The final clearing has been undertaken of the great temple of the moon-god Nannar, whose history was traced from the foundation of the building by King Ur-Nammu in about 2300 B.C. until its last restoration by Nebuchadnezzar in the sixth century B.C. From excavation on the line of the city wall, information was obtained as to the defences of the town in the time of Ur-Nammu, and later in the year the most notable discoveries were those in the prehistoric cemetery. More royal tombs were found, two of which gave entirely new information as to the ritual of a king's funeral; one of these was intact, and the tomb-chamber, over which the stone dome was found unbroken, contained some remarkable gold objects. Much richer than this was a "death-pit" containing seventy-four bodies, many of them lavishly decorated with gold, and also four harps and two statues; these are among the finest objects of art yet discovered at Ur. Other graves produced a very large collection of funeral furniture in gold, silver and copper, as well as stone and clay. Finally, mention must be made of the digging at a lower level than the graves, which resulted in discovering evidence of the historical character of the Flood.

* * * * *

The tramways of London have lately been the subject of much discussion in view of the new arrangement by which they will shortly be worked in conjunction with the omnibus services. While the political aspect of the matter is outside the scope of these columns, there have been at the same time suggestions that the tramway as a mode of locomotion is out of date, one reason being that the cars are very noisy as compared with the rubber-tyred motor bus. Much interest, therefore, attaches to a new device which is reported from America and is claimed to overcome this disadvantage. On the outskirts of Los Angeles there is now being tried out a "continuous rail," which consists of a small round plate with a single groove, installed at intersections of the line. When a tram crosses over points at a turning or crossroad, the miniature turntable faces automatically in the direction of the approaching car, so that bumping over the grooves is completely eliminated. As an American newspaper remarks, the rolling stock as well as the ears of city dwellers are in consequence submitted to many fewer shocks. If the invention does all that is claimed, we hope that it will find its way to England, where it would be welcomed in London and many other cities.

* * * * *

Since the renewed recognition of its national status, the Vatican City has lost no time in bringing its organization up to date. In addition to the new railway station which is to be constructed, an order has already been placed for a wireless station, to be installed for the use of the Pope and the state authorities. The manufacture of the apparatus has just been put in hand by the Marconi Company, and it will involve the latest improvements in design. Appropriately the work is receiving the personal supervision of Mr. Marconi, the Italian pioneer of wireless.

*The "Next Step."—VIII.*

# Aviation Spreads its Wings.

**By Colonel the Master of Sempill.**

*President of the Royal Aeronautical Society of Great Britain.*

*The twentieth anniversary is just being celebrated of the first flight over the channel, which affords an appropriate occasion to consider the future of aviation, and what developments are most likely to occur.*

A FEW days before this article appears in print, we shall be celebrating the twentieth anniversary of M. Bleriot's famous cross-channel flight. It hardly seems possible that only twenty years have passed since our age-long security as an island nation was violated by a power-driven heavier-than-air machine. On 25th July, 1929, M. Bleriot plans again to cross the channel by air, but this time in a large multi-engined liner that is in constant touch by wireless telephone with the ground stations in France and in England. Seated in an armchair, no doubt enjoying a well-served lunch, M. Bleriot when half-way across the channel will see a formation of Royal Air Force aeroplanes sent to escort him to England. Receptions are to be held at Dover and Croydon in his honour and representatives of the air community, headed by Lord Thomson, the Secretary of State for Air, will welcome the pioneer aviator. In the Science Museum at South Kensington the Royal Aeronautical Society holds a reception in the shadow of the wings of the Bleriot monoplane in which the historic flight was made. This machine has been specially loaned by the French authorities for the occasion, and is housed alongside the Wright aeroplane, in which the first flights ever made in a power-driven aeroplane were accomplished by the brothers Wilbur and Orville Wright just over twenty-five years ago.

### The International Exhibition.

Furthermore, the International Aero Exhibition held at Olympia last month provided a unique opportunity for the general public to examine at close quarters the latest types of civil and military aircraft that are being produced in all countries of importance. It was possible by studying the exhibits of the Air Ministry and the Royal Aeronautical Society to compare these modern machines with the models, photographs and prints of the earliest types of aircraft.

Great Britain has played a very important part in the development of aeronautics, a part better appreciated and recognized outside this country than within. We are not, however, so much concerned here with the past as with the future—although we must never forget those who made present developments possible and endeavour to profit by their hard won achievements of twenty years ago. The real development of aeronautics to-day is becoming more and more centred in persons utterly unknown to the public at large. The days when the names of those few who were concerned with the conception and design of aircraft were known are now past. To-day a small band of modest and extraordinarily efficient individuals at the various research establishments (of the Government and of certain firms) and at the universities are unremittingly working to solve problems on which improvements in future designs depend. Those who have been privileged to work in contact with these few will realize how much we owe to them.

### British Progress.

From the point of view of scientific research we can without boasting congratulate ourselves on being in advance of other nations. We may not have in all respects the same elaborate and up-to-date apparatus, nor the same financial resources as certain other countries, but we have personnel—on the whole better able to solve the highly intricate problems that face the research worker to-day. Had we really appreciated as a nation our position in aeronautics ten years ago and, more important perhaps, the large part that this new science was destined to play in our daily lives, then we could have been from every aspect—scientific, technical and operational—well to the fore instead of lagging behind other nations who have come up and passed us.

One of the most important steps of the future will be in relation to improvements in the engine, not only towards achieving appreciably greater economy of running and reliability, but also towards a reduction in weight per horse-power. There are certain special engines in existence to-day weighing even less than 1 lb. per h.p., but these are the exception, and the average figure is over double. The future type of civil and commercial machine will be fitted with more than one engine so as to reduce the inconvenience and

possible dangers of a forced alighting to a minimum. The reliability of engines to-day is good, but there is still room for improvement, although it is no use imagining that infallibility can be attained. The production of lighter engines would certainly enable greater regularity of flight to be achieved by making economically possible the production of the multi-engined machine.

### Greater Safety.

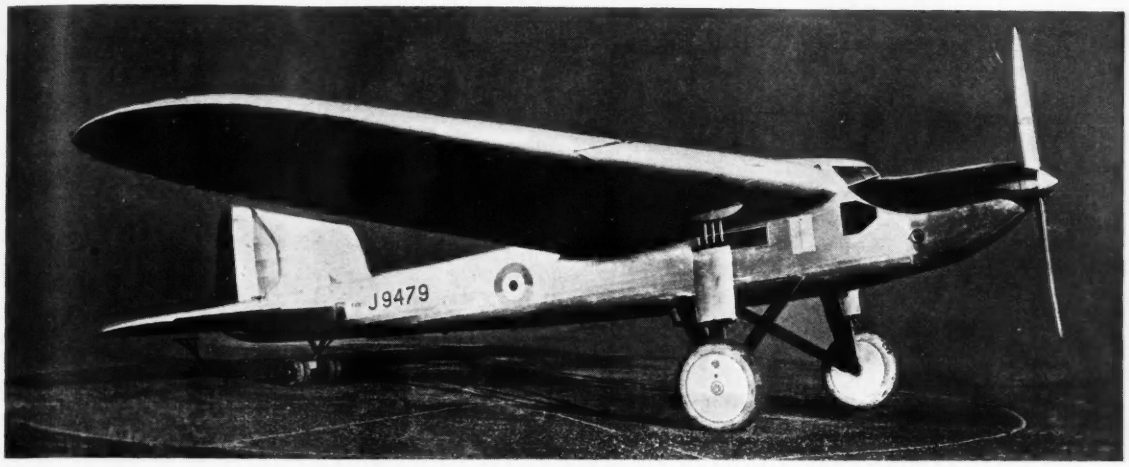
The introduction of the compression-ignition engine, or as a step in that direction the modified form of internal-combustion engine of the Hessleman type that will burn Diesel oil or gas oil, will certainly tend towards greater economy and safety from fire risk. The efficiency of the internal-combustion engine, although greatly improved in recent years, leaves a great deal to be desired when compared to that of certain other prime movers. Air-cooling will, it is thought, become universal for all ordinary purposes, since water-cooling or liquid-cooling results in the production of too heavy, costly and complicated a unit. The " poppet-valve " arrangement will probably be superseded by the single-sleeve valve of the Burt type. Engine speeds generally will tend to increase, thus necessitating the almost universal adoption of a reduction gear so as to obtain reasonable air-screw efficiency. Air-screw efficiencies to-day as high as 75 per cent are possible, but a figure of 85 per cent may be looked for in the future. The use of variable-pitch air-screws offers advantages that will probably warrant their adoption in certain cases, and the same may be said of the super-charger.

In the development of the machine itself the question of obtaining greater safety—and one might say fool-proofness—is by far the most important. Aircraft are being flown more and more under all weather conditions both by day and by night, and it is essential that reliance on the skill of individual pilots for the safety of the machine should be reduced as far as possible. The majority of accidents are due to stalling or loss of speed resulting in nose-dives and similar uncontrolled manoeuvres, all too often ending in disaster. The development of the Handley-Page slot linked with the aileron control is a matter of the greatest importance, and it may be confidently predicted that such an arrangement bids fair to become universal. The all-round improvement in controls under all conditions that will result will remove from the minds of pilots the fear of disaster that may often result from the loss of flying speed under conditions of bad visibility or other peculiar circumstances.

In the structure of aeroplanes the use of metal—except perhaps for the smaller machines—will become general. The economic situation in various countries will play quite an important part in determining whether steel or light alloys of the duralumin variety shall be employed. In the larger sizes there may be possibilities for metal covering of the wings, but in the main fabric as now used will continue to fill the bulk of the requirements as it gives good service and is advantageous from a weight point of view. The general tendency will be for machines to be developed with a higher aspect ratio as structural methods improve and with experience also as a more precise knowledge of interference between wings and body is gained. At the present moment too vast a gap exists as between the power actually expended on flight with a modern aeroplane and the power necessary for flight in a machine of ideal aerodynamic form. Improvements in the aerodynamic qualities of aircraft can certainly be expected, and it is somewhat remarkable that so little has been done except in a few isolated cases to reduce drag and thus avoid wastage of power. The more general adoption of the monoplane arrangement for technical and operational reasons may be expected. New structional methods are being developed which should result in the one great disadvantage of the monoplane as compared to the bi-plane—that of a high structure weight being satisfactorily overcome. The totally enclosed machine will gradually become universal as will cabin heating and other aids to comfort.

### The Problem of Noise.

The problem of noise is both serious and complex, but improvements may be expected as a result of more careful design of cabins, by the utilization of engines with reduction gears and thus with slower running air-screws and by improvements in the aerodynamic form of the machine itself. More attention too can with advantage be given to the disposition of the engines and air-screws in relation to the wings and the body. Even though all these points are taken into consideration, it is no good closing our eyes to the fact that such improvements will probably not be considered sufficient by the air-travelling public, who will become more critical. Up to the present, aircraft have in the main been used by enthusiasts who have either closed their ears to such defects or have become, through the course of years, used to the disadvantages perfectly obvious to the newly-fledged air-travelling public. The solution of this problem is one of the most important before the Aeronautical Research Committee.




THE FAIREY MONOPLANE, THE MOST EFFICIENT BRITISH MACHINE OF TO-DAY.

The flying boat will well repay very intensive developments, particularly in so far as our Imperial needs are concerned. Viewed broadly, particularly when we consider the large machine, the flying boat for technical reasons of a constructional and operational character holds advantages over the aeroplane. It may, in fact, be fairly stated that the maximum size of an efficient flying boat will exceed that of the aeroplane in the ratio of about two to one. As to the size of aircraft generally, many hold that the recent fifty-ton Dornier machine, now being flight-tested in Germany, has already surpassed the limit beyond which increase of size would not be profitable. Improved methods of construction and improved materials will undoubtedly enable larger machines to be produced with a satisfactory ratio of disposable weight to gross weight. Up to the present, most large machines constructed have carried a relatively low percentage of useful load.

### Ground Organization.

In the British scheme of commercial air routes, we not only want an extension of routes to be flown over by day but an extension—or one might say creation, as none exist—of routes to be flown over by night. The advantages of aerial communications over long distances can only be benefited by to the full extent by continuous operation at all times and in all weather conditions. This necessitates a highly efficient ground organization which will enable the pilots to receive weather reports of the route about to be traversed. Aids to navigation such as directional wireless must also be available, and it would be true to say that the success of an air route depends primarily on highly efficient ground organization.

The question of suitable aircraft for air routes is also a matter of considerable importance as aviation can only be made to pay by employing the latest and most efficient types that designers can produce. Under the present system a highly efficient organization keeps obsolete machines in commission for five years or even more, when such machines from the point of view of general advancement could have been profitably scrapped in two years. These are arbitrary figures but serve to make a point. It is suggested that it would pay us handsomely as a nation to subsidize the monopoly company in such a manner as to enable it to scrap old machines and replace them by new as soon as an advance in design warranted such a change. Such an important decision could be left safely in the hands of the supreme technical authority the Aeronautical Research Committee, who have available all the information that would enable them to come to a wise decision.

All the remarks above relate to heavier-than-air craft, but it must not be assumed that the importance of lighter-than-air craft is unappreciated. For the long overseas journeys the airship will, it is fully believed, prove to be the most suitable means of transport. It does not suffer from the same limitation in size as in the case of the aeroplane, indeed it becomes a more economic unit as the size is increased. The fact that two large airships are approaching completion in this country does not, even assuming that these designs are successful, signify a decreased use of heavier-than-air craft, but rather the contrary by the broadening out of the whole field of air transport far beyond its horizon to-day.

# The Strangers on the Lake.

By Oliver G. Pike, F.Z.S.

*The rare experience of finding and photographing a pair of birds not previously known to have nested in England was enjoyed by the author, who here describes the black-necked grebe which recently visited a lake near London. Mr. Pike regards this as one of his most interesting observations.*

MANY times I have been asked which is the best spot in England for studying bird-life. It is difficult to answer such a question, for there are so many places of equal interest, but there is a group of lakes only thirty-five miles from London, which could be included in the best half dozen bird haunts in the British Isles. As the nature-lover wanders around the Tring Reservoirs, in Hertfordshire, there are sure to be surprises, for many rare birds linger there in their flight over the country. Large numbers of great-crested grebes, many species of ducks, water rails, coots, moorhens and dabchicks nest there in safety, for all are strictly protected, and birds are quick to find out such spots. If they find that they are unmolested during a whole nesting season, they and their offspring will be found there the next season.

When the bird photographer has travelled all over Britain and photographed nearly all the birds to be found nesting in the country, it is easy to understand his excitement, when on a lake only a few hundred yards from his home, he saw two birds which had not been recorded as nesting before in England. This was my fortunate experience, for I saw on the Tring Reservoirs a pair of black-necked grebes, and was able to prove that this was their first time of nesting in England because they were feeding their two young. The following year I was delighted to find that these beautiful birds had come again to the lakes. As I watched them swimming about, it seemed to me that it would be difficult to find two more devoted lovers in the whole of birdland, for they were seldom far apart. If one bird dived for food, the other instantly followed, for they seemed to spend their time on the water, and also underneath, as much as possible together. After they had been on one of the lakes for about a fortnight they began to build their nest, and after a long search I discovered it well hidden among the reeds. It contained five eggs. I built a " hide " on the water about thirty feet from the nest, intending to leave it there several days, so that the birds should get used to it before I began my photography.

When I visited the lake the following morning, I saw both birds together on the water, and thought it strange that the hen should not be sitting, and on going to the nest, I found that all the eggs had disappeared. I believe a moorhen was the culprit, for this bird is a great egg-thief and takes large numbers of eggs from the nests of other birds which nest in its neighbourhood. There was now nothing to do except watch the birds again, hoping that they would construct another nest. A week later they showed signs that they were doing this, but they refused to give away the haunt, for they entered the reeds far from their new home, and swam to it behind the scenes. So once more I began searching by pushing my boat into the reed-bed as far as possible, then looked around, and not finding it, I tried another

ARRIVING AT THE NEST

place, and where I could not take the boat, I waded. After a week's really hard work I discovered what I believed to be the nest in a corner of the lake, where the reeds were very thick and tall.

There were numbers of dabchicks also nesting on the lake, and the nest of this bird is the same size, and the eggs are similar to those of the black-necked grebe, but I felt sure that I had discovered the rare nest, for when I went near it, the two birds became very excited on the water just beyond the reeds. This time I built my hide on a punt, and moved it each night a few yards nearer the nest, so as not to disturb the birds more than possible. At last it was in the desired position and the following morning I went inside with my cameras, hoping to obtain some interesting photographs. My assistant left me at ten o'clock, and I arranged for him to return with the boat at six in the evening, so I was in for a long wait. After he had left me, and when it was too late to call him back, I heard a splash near the nest before me, and to my great disappointment a dabchick appeared! I had taken all this trouble over one of the commonest birds to be found on the lake, and I was destined to remain in the hide many hours, with a bird before me which I had photographed repeatedly. Six o'clock at last arrived, and I determined to spend the remaining hours of daylight in searching for the nest that I so much wanted. But we failed to find it that evening, and it seemed to me that it was impossible to discover another nest on that large lake.

BEWARE TO THE INTRUDER!

The nest was, however, found the following morning in a remarkable manner. That night I had two dreams about the bird. In the first I saw the nest in an impossible place—under my dining-room table! But in the second, I saw it very vividly in a certain spot on the lake. The following morning I decided to test my dream, and rowing across the lake to the place where I had seen it so clearly, I moved the reeds aside with an oar, and there, just under the bows of the boat, was the nest. Wasting no more time, I brought my hide from the dabchick's nest and quickly fixed it in position, and a very few minutes after I was inside, the black-necked grebe arrived. When we see this beautiful water-bird at close quarters, the first thing we notice is the bird's wonderful eye. It looks like a fine ruby gleaming in the sunlight. The bird showed no signs of fear, but went straight to her nest, uncovered her eggs and settled down. She seemed very devoted to her eggs, and repeatedly changed their position. After she had been sitting for about two hours, the dabchick, which had her nest not very far away, left her home, came to the black-necked grebe and tried to drive her away. A desperate fight took place, the dabchick jumping on to the front of the nest, then taking hold of the sitting bird's beak, pulled her down, and almost had her in the water, but the bird above fought her way free, and eventually after a struggle drove the enemy off. If the dabchick had won the fight, I expect she would have jumped on to the nest and quickly destroyed it, for birds show great signs of jealousy when strangers, like these grebes, appear in their haunt.

When the hen grebe had sat for three hours, the male appeared to take his turn upon the nest. I watched the birds for two whole days and found that they changed the guard, as we might call it, about every three hours. In my nesting experience, going back many years now, I have seen many male birds sit upon the eggs, or brood on the young, but I have never seen any bird so bored with his task as this male black-necked grebe. To put it in plain English he was absolutely fed-up with his job before half-an-hour had passed. For the first half of that time, he preened his feathers, then finding that all were in the right

position he watched the other birds fly past, no doubt wishing he was with them. After that he laid upon his side on the nest, with one leg dangling over the side, which he waved languidly to and fro! At last he pulled this under his body, and as there was really nothing else to do, he drew his beak well into his breast feathers, closed his eyes and went to sleep. But something now happened, which proved to me that he was really very much on the alert, for that interfering dabchick appeared again. Last time she came, she had the female to contend with, and she little knew what she was going through on this visit, otherwise I am sure she would have stayed away.

The instant the male heard the enemy approaching, he jumped up on the nest, hurriedly threw water-weeds over the eggs to cover them, then crouching down with a protecting wing on each side of the nest, he waited for the dabchick to approach. His beak was open, and as the enemy swam around waiting for an opportunity to spring, he turned, giving out low hissing notes. Suddenly the dabchick did spring, and she was met with such a wild onslaught of beak and wings, and received such a thorough drubbing, that when able to escape she quickly turned tail, and swam off. After all this excitement the male guardian was very much on the alert, and if any other birds swam by, he kept his bright eyes fixed upon them until they were well out of sight. But no more birds did molest him, so he prepared for one more nap.

After he had been sitting for another hour, the hen appeared, and I never saw any bird put on such a delighted expression as this male grebe did when he saw his mate. To show his appreciation at her return he dived to the bottom of the lake several times, and brought up large beak-fulls of weed, which he presented to her as she settled down on the eggs. Then feeling that he had performed his duty, and performed it well, he went out on the open lake for three hours of recreation. I spent several days in the company of these birds, and those which I gave up to photographing them were certainly two of the most interesting that I have ever spent in birdland.

# Fresh Light on the War of Independence.

**By R. B. Mowat.**

*Professor of History in the University of Bristol.*

*At a time when Anglo-American relations are being widely discussed, it is well to study afresh the contemporary documents on which their record is based. A collection of letters written in 1776 by German mercenaries suggests that there is no ground for much of the bitterness alleged by later historians.*

THE history of the American Revolution is naturally of absorbing interest to the citizens of the United States, many of whom can trace their ancestors among the actors in that great drama. Nor is this interest in the United States confined to citizens of originally British stock. French and Germans took part in the struggle, and their efforts are lovingly investigated by scholars and by societies of French or German origin at the present day. The names of Lafayette the Frenchman and of Steuben the Prussian stand deservedly high on the roll of history. There are many other names, of lesser note, from the continent of Europe.

The continental Europeans, however, were not all on the Revolutionary side. Large numbers of them were fighting as mercenaries with the British forces. The British Army was never meant for war on the grand scale, and has always suffered, in such circumstances, from having insufficient numbers of men. In 1775 the only considerable body of British troops in the American Colonies was shut up in Boston, undergoing a siege that was to last eleven months. "It was not the King's fault," writes Sir George Trevelyan. "His Majesty had long contended that the Peace establishment, in both the Services, was far too low." Efforts were made to increase the supply of men from the British Isles, but time was short and the need was pressing. Germany had for many years been a recruiting ground for foreign princes. George III's Government therefore looked to it as a possible source of supply. As Elector of Hanover King George was able to secure the services of five Hanoverian battalions. They were given pay at the British rate, "which was on a much more generous scale than was fingered by the inmates of any barrack in Germany." Moreover, all ranks were given a new outfit, at the expense of Great Britain. Other German princes allowed men to be recruited in their territories for service with the British Army in the colonies. Still other princes hired out troops by whole battalions to the British Crown.

In return the princes received a subsidy for themselves; their troops received British pay. The

Duke of Brunswick in this way agreed to supply 4,300 men and to keep the force up to strength. His reward was £15,000 a year. The men were not volunteers; they were sent to serve with the British as part of their military duty. Recruits were obtained by conscription. The Landgrave of Hesse supplied 12,000 men. His reward was £110,000 a year. The Brunswick troops went out in 1776 to Canada; the Hessians went to New York. The rest of the foreign troops went to one or other of these theatres of war. Many of the letters which the officers sent home to their families in Germany have been preserved. They show the officers who wrote them as men of intelligence and of humanity.

### Canada in 1776.

One of the letters gives a detailed description of Canada as it appeared to a German staff officer in 1776. "In all Canada," he writes, "there are but three cities, and all three lie on the St. Lawrence River—Quebec, Trois Rivières, and Montreal." The inhabited country was divided into parishes. "A parish is a sort of village, whose houses do not stand close together, but lie one hundred, two hundred, often six hundred yards apart (sporadically), and are even interrupted by forests." Canadian agriculture was observed to have much similarity to that of Bremen; "very good wheat" and "fair barley and oats" were grown. Every *habitant* had abundance of hens, turkey and geese. "You see no tame ducks, because they desert to the rivers, nor are there any tame pigeons. Wild pigeons and ducks, on the other hand, are found in super-abundance." The way of life of the Canadians is described attractively:—

> In their housekeeping they are extremely neat and exact; no nation can get along so economically. All summer the Canadian lives on bread, which is as white as snow, milk, vegetables, and flour; his cattle, hens, etc., he saves for the long winter, and then he is said to live very well. Their thrift is noticeable in their furniture and things, which in part date back to the century of Louis XIV.

The journal of a German officer describes the march through Canadian territory into the rebel colonies, ending with the disaster of Saratoga. The country was not good to march in, yet the men did not, all things considered, fare badly. Rocky defiles through which the troops had to march reminded the officer of the Harz country. The St. Anne River, which was crossed on boats, "can surely contest the palm with the Weser." Tall frigates were seen on the St. Lawrence, far above Quebec. On the march the men were often up to their knees in mud and water. When they came to a river, boats were collected from the neighbourhood, but the soldiers had to row themselves across. The German soldiers "had absolutely to learn this in Canada," while a British soldier held the tiller and managed it very well. When the army came to the region of the lakes, they saw quite a fleet of small British warships. The troops were given good winter quarters in October, 1776, onwards. The British Government always, if it is humanly possible, feeds its troops well. After the winter of 1776-77 was over, a German officer wrote to friends at home who had written pitying him: "We have had more than enough beef, pork and mutton, since February 20th; veal, also hens, capon, geese, partridge and hare. Nor have we lacked white cabbage, turnips, beets, turnip-rooted cabbage, or good dried peas and beans; to be sure we had to forego red cabbage, lentils and certain other vegetables, venison and wild pig."

After all, one could not expect all the good things of Westphalia in the middle of the Canadian forest. Yet in addition to the substantial list of eatables already noted, the officer adds to his account fish, flour, butter, pastry, young bear, beaver tails, elk-roast, caribou. He adds: "*Do not think that our privates are at any great disadvantage compared with the officers.*"

> Both (*i.e.*, officers and men) must take their ration, for which two and a half pence is deducted from their pay, daily. In praise of our general-in-chief I must say that through his concern especially the German soldier gets for this deduction two and a half pounds of beef and one and a half pounds of wheat flour, an allowance which even the healthiest stomach will hardly digest each day. If a soldier gets but one pound of meat and one pound of bread or flour, he gets excellent English peas and very good Irish butter, or rice.

### No News from Home.

The soldiers, as a matter of fact, used to trade some of their surplus rations for the chickens and other good things of the people with whom they were quartered. Two men, at most three, were billeted together in a house; "they lived in healthy rooms with good straw beds at any rate." There was very little sickness in these winter quarters. The chief objection to them was that no news came through, as long as the winter lasted, from Europe. In March, 1777, the officers did not even know what military events had taken place in New York, New Jersey, and Pennsylvania during the preceding autumn.

In summer, 1777, the army of Canada started on its march to the Hudson Valley under General Burgoyne, the campaign that was to end with the disaster of Saratoga. On 11th August a musketeer called Fesselabend from Cologne was shot in front of the pickets of General Riedesel's force. "He had deserted,

gone over to the enemy, taken service with them, and been captured again by us."

On 14th August the army marched seven miles down the Hudson. "The heat to-day was cruel," writes one of the German officers; "many soldiers were in danger of suffocating on the march." They were now in the territory of the rebel colonists. On this day the men encamped around the house of a member of the Continental Congress, who was a commissariat officer in the Revolutionary army. The German officer writes: "His country house here is only wooden, indeed, but large and built with good taste; it is the first regular country house which I have seen since leaving Portsmouth."

### No Deserters.

There was a good deal of hard fighting against American "Regulars," as well as against the inhabitants of the valley who had taken up arms. After every such fight, there were many soldiers "missing"; it was impossible to trace the casualties; the forest swallowed up the fallen men. A good many of the Colonists came up from Albany and joined the King's troops. "We shall soon have a full regiment of Provincials," writes the German officer. Being used to the frightful conditions in continental European armies in the eighteenth century, the officer, in spite of the occasional capture and shooting of deserters, writes: "It is also true that probably never did an army have less deserters than ours has had." The rebels continually tried to seduce the King's soldiers to desert by sending emissaries, some of whom were English, some German.

The end of the Hudson Valley campaign was near. The King's army numbered only about 7,000. Supplies were becoming scarce. "From Mother Canada we can expect nothing more," a German officer wrote. "We must seek our bread by our arms, and make another way to get it either in the vicinity of friends and foes, or from Europe over other ocean lanes and other rivers and lakes." After much hard fighting, General Burgoyne and his men laid down their arms before the troops of Generals Schuyler and Gates at Saratoga Springs on 17th October, 1777. The American regiments showed not "the slightest sign of mockery, malicious delight, hate, or other insult," as the men marched past.

The King's troops were taken away as captives to Boston, on condition of being allowed to go back to England in British ships. A German officer, a prisoner of war at Cambridge, just outside Boston, found himself in pleasant quarters. "To be sure," he writes, "we are rather restrained, and they have definitely designated a circle which we are not to pass, and they have also said something about guardships and shooting to death, if we do not comply. But in our stockades we do not forego much of the freedom that clings to us in regard to our persons, and now and then play the master among our conquerors."

The students of Harvard College, or "the University at Cambridge," as the German officers called it, were still in session, in spite of the war. "The students live in the well-built *Collegio Herwardino*, go to lectures in queer house-jackets (presumably, undergraduate's gowns), and are summoned by the bell thrice daily—to breakfast, dinner and supper." On the march after the capitulation at Saratoga, the German officers had been able to observe the condition of the settled country towards Boston. "Most of the houses were well built and the interior fitted with very good furniture. The inhabitants lived extremely well; their breakfast consists of tea with milk, which roast meat, baked apples, and all sorts of rich pastry must accompany." The prisoners were well treated, but after a few weeks internment they found life very tedious. "We have absolutely no real active occupation; we have no books at all to fill out our empty hours by reading."

There are other letters extant describing the beauties of Long Island, its meadows and tilled fields; the hot climate of Virginia, and its stately well-furnished houses of fourteen rooms; New York, "one of the prettiest, pleasantest harbour towns I have ever seen—its houses, not only built fine and regular in the English style, most of them like palaces, but all papered and most expensively furnished." When the German soldier saw the Americans so comfortable and prosperous, he wondered why they were in revolt.

### A Civil War.

All civilized peoples share the same virtues, but in different degrees. The characteristic virtue of the English people and of people of English stock is tolerance. This is the reason that the English Civil War in the time of Charles I and Cromwell left no bitterness behind it; and that the American Civil War of the time of Lincoln and Lee came and went without spiritually dividing the American people. The Revolutionary War which gave birth to the United States was just a civil war inside the English people of the reign of George III. The more its authentic historical material is investigated, the less reason does there seem for the acrimony which later historians, both English and American, until a few years ago, were apt to display.

# The Safety of Life at Sea.

**By Lt.-Col. Chetwode Crawley, M.I.E.E.**

*Deputy Inspector of Wireless Telegraphy, G.P.O.*

*The report has just been published of a new convention regarding the safety of life at sea. Much of this deals with wireless, as in this direction the greatest progress has been made since the previous conference.*

An International Conference on the Safety of Life at Sea met in London during April and May to revise the International Convention which had been signed in London in January 1914. As a matter of fact, the 1914 Convention, due to the war, was never ratified, but many of the regulations introduced since then have conformed in general to the proposals in the new draft Convention which was published last month. These British regulations have been, indeed, more stringent than those imposed by other countries, and a considerable part of the new document is in line with regulations already in force in this country, but it is certainly a great step in advance to have them included in an international agreement. The new Convention, which is of course also subject to ratification by the governments concerned, will not come into force until the 1st July 1931, so that there is plenty of time for consideration by the various governments and for preparations to comply with the new regulations.

### Three Problems.

The three main problems with which the Convention deals may be grouped under the headings of Life Saving Appliances, Radio-telegraphy, and Safety of Navigation, but it must be understood that many matters are considered which do not come strictly under any one of these headings.

Under life saving appliances, the most interesting sections deal with lifeboats. Here it is definitely laid down that there must be accommodation in boats for all persons on board, and in addition it is stipulated that there must be " buoyant apparatus " for twenty-five per cent of the persons on board. There must also be a life jacket for every person, and a supply of lifebuoys, each of approved pattern. Such regulations would be of little use if the lifeboats and apparatus were not readily available, and various regulations are inserted with this object in view. That is of course the whole crux of the matter. After every great disaster at sea the cry of " boats for all " is always raised. The need has always been recognized, but the difficulty has been, not in having boats for all, but in having them readily available, and it is to be hoped that the Convention's rules will help to solve this difficult problem. At any rate they try to do so, and this in itself is a great advance.

Another interesting section deals with Muster Rolls and Drills, and anyone who spends much of his time at sea will agree that there is plenty of room for improvement in the methods of dealing with these safety measures on many ships. The Convention lays down that special duties for the event of an emergency shall be allotted to each member of the crew, and that these special duties shall be shown on a muster list which must be posted up in several parts of the ship. Musters of the crew for boat drill shall take place weekly when practicable, and if a muster is not held, the reason why it was not practicable shall be stated in the log book. Musters of passengers are to be held for practice at an early period of each voyage where this exceeds one week, the signal for summoning passengers to muster stations being a succession of more than six short blasts, followed by one long blast, on the whistle or syren. In addition, on all ships, with the exception of short voyage ships, this signal will be supplemented by electrically operated signals throughout the vessel, and the meaning of all signals affecting passengers must be stated in different languages on cards displayed in cabins and other passengers' quarters.

### Wireless Requirements.

The development of wireless telegraphy in connexion with the safety of life at sea is by far the most striking advance made since the 1914 Convention, and the most interesting part of the new document is that which deals with this subject. The 1914 Convention proposed that all ships which have on board fifty or more persons should be equipped with wireless telegraphy, but in this country it was laid down ten years ago that all passenger ships and all cargo ships of 1,600 tons gross and upwards must be so fitted. The new Convention comes into line with this British regulation, but stipulates that cargo ships of less than 2,000 tons need not be equipped until five years from

the date on which the Convention comes into force. Certain exceptions are of course allowed for, including existing sailing ships, short voyage ships, and ships employed on certain specified voyages.

In 1914 very few ships were fitted with wireless directional receivers, which were indeed at that time only in the experimental stage. Now, however, the situation is completely changed, although the number of ships fitted with this apparatus is still small, about twenty per cent in the case of British ships equipped with wireless. With directional receivers, ships are enabled to take their bearings from other ships or stations which are transmitting wireless signals. In normal conditions the bearings can be taken with an accuracy of two degrees, so that the importance of the larger ships being fitted with this apparatus from the safety point of view is obvious. So far, there has been no obligation in any country for ships to be fitted with directional receivers, but within two years of the new Convention coming into force every passenger ship of 5,000 tons gross and upwards will have to be equipped with an approved direction-finding apparatus or radio compass. This will undoubtedly form an important addition to the compulsory safety appliances in passenger ships, though of course most of the larger ships are already fitted.

### Directional Bearings.

The Convention lays stress, too, on the utility of direction-finding apparatus capable of emitting synchronized wireless and underwater signals, and on that of echo depth sounding apparatus, but no regulations on these matters are laid down. In this country, seven stations are equipped for giving bearings to ships which are not equipped with directional apparatus, and there are eight stations which send out signals automatically so that ships fitted with directional receivers can take their bearings from these stations. Three of these latter stations emit synchronized wireless and underwater signals which allow of a ship obtaining not only its bearing but also its distance from the station, by noting the time which elapses between the receipt of the wireless signal and the underwater signal. A new form of wireless beacon station has just been opened at Orfordness, in Suffolk.* This station emits a rotating beam of wireless signals, which enables a ship to obtain its bearing by means of an ordinary non-directional receiver. This is the first station of its kind in the world, and there has not yet been time to judge of its practical utility.

Besides directional wireless, another outstanding wireless development for safety purposes has taken place since the Convention of 1914, namely the Auto-alarm. This instrument consists of a wireless receiving apparatus which responds automatically to the Alarm Signal, and to no other signal. It has been fitted in many British ships during the last two years, but no such apparatus had even been designed, much less used, in any other country until a few months ago. The use of this apparatus was brought to notice internationally by the British Delegation at the International Radio-telegraph Conference at Washington in the autumn of 1927, but the idea was not received with much enthusiasm, in fact there was some apprehension regarding the practical working of such apparatus. The experience gained in British ships since then has shown that the apparatus is successful in practice, and the Convention recognizes it as a practical watchkeeping device for safety purposes. The Alarm Signal, which is transmitted immediately before the Distress Signal, consists of a series of twelve dashes sent in one minute, the duration of each dash being four seconds, and the duration of each space between dashes, one second. The Auto-alarm apparatus is so designed that this particular signal operates it in such a way as to ring a bell, by which means the operator is called to the wireless cabin. The International Radio-telegraph Convention which came into force this year did not specially recommend the use of the Alarm Signal, but the Safety of Life at Sea Convention recommends that the next International Radio-telegraph Convention should prescribe that the Alarm Signal shall, as a general rule, precede the Distress Signal, as it is anticipated that many of these receivers will be installed in passenger and cargo ships in the near future.

### Watch-Keeping.

As regards wireless watchkeeping for safety purposes, the Convention lays down that, with certain exceptions, continuous watch must be kept on all passenger ships over 3,000 tons and on all cargo ships over 5,500 tons, that at least eight hours watch a day must be kept on cargo ships of between 3,000 and 5,500 tons, and that the watch on other ships must be kept as determined by the government concerned. In all cases a qualified wireless operator must be carried, and on ships which are fitted with an Auto-alarm, this apparatus must always be in operation at sea when the operator is not on watch. Instead of fitting an Auto-alarm, ships are at liberty to keep the required watch by operators or watchers. The qualifications of operators are laid down internationally, but hitherto the watcher has not been internationally recognized. The new

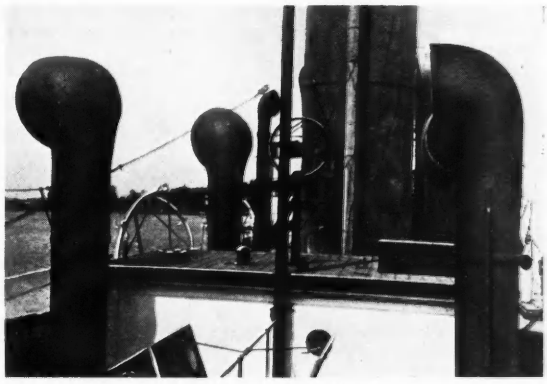
*For a description of this station see *Discovery*, November, 1928 : "Wireless as an Aid to Navigation."

Convention requires that a watcher shall be able to pick out the Alarm, Distress, Safety and Urgency signals, and be able to read code groups at a speed of sixteen groups a minute. This is a higher standard than has hitherto been in force in any country for watchers, as it has been found in practice that former standards did not produce satisfactory results.

The technical requirements for the wireless installations to be fitted in ships are the same as are at present in force in this country, but it is satisfactory to have these requirements recognized as international regulations. The main set in a ship must have a range of at least one hundred nautical miles to another ship fitted with a simple receiver, and there must be an emergency set if the main set does not comply with all the requirements laid down for the emergency set. This emergency set must have a range of at least eighty nautical miles in ships required to keep continuous watch, and fifty miles in all other ships.

The Convention makes no provision for wireless telephone sets. As mentioned above, all ships compulsorily fitted with wireless must carry a qualified wireless operator, and in such circumstances communication by wireless telegraphy has several technical advantages over wireless telephony. For example, wireless telegraphy gives greater range for the same power, it provides more possible channels of communication, and the language difficulty is much less troublesome. Indeed, the only mention of wireless telephony in the Convention is a warning against its use on waves close to the distress wave, as such would render inoperative Auto-alarm receivers which would be adjusted to receive the Alarm Signal on that wave.

SET FOR SMALL SHIP.
This wireless set, designed for small ships, meets the requirements of the new safety convention.



DIRECTIONAL WIRELESS.
The circular metal ring, seen in the centre of the photograph, is the wireless receiving aerial for the directional apparatus.

As regards lifeboats, it is laid down that in a ship which carries more than thirteen, these shall include a motor boat, and if more than nineteen are carried, two shall be motor boats. These motor boats must be fitted with wireless telegraph apparatus and a searchlight.

In the Safety of Navigation section great importance is attached to co-operation between maritime countries in the collection and distribution of meteorological data by wireless telegraphy, and general rules are framed with this end in view. Rules, too, are inserted to the effect that the Master of a ship is bound to proceed with all speed to the assistance of persons in distress, and if for any reason he fails to do so he must enter his reasons in the log book.

But the most interesting article in this section, and indeed, in the whole Convention, is that dealing with Helm Orders : " The Contracting Governments agree that after midnight on the 30th June 1931, helm or steering orders, *i.e.*, orders to the steersman, shall on all their ships be given in the direct sense, *e.g.*, when the ship is going ahead an order containing the word ' starboard ' or ' right ' (or any equivalent of ' starboard ' or ' right ') shall only be used when it is intended, on ships as at present generally constructed and arranged, that the wheel, the rudder blade and the head of the ship, shall all move to the right." An age-long discussion is thus definitely closed.

# The Greece of the Far East.

**By the Rev. Walter Weston, M.A.**

*Late Honorary Secretary of the Japan Society.*

*In particular from researches in Greek literature, it has been discovered how many points of resemblance there are between the Greeks of old and the Japanese of to-day. Both countries are geographically similar, and the way in which environment has affected their peoples forms an interesting study in comparative ethnology.*

In an essay on the civilization of India, China and Japan, Professor Lowes Dickinson once observed that Japan was the only country he had visited which reminded him of what he supposed ancient Greece to have been. "The resemblance between the two peoples," he added, "is more than superficial." During my own residence of many years in Japan, which afforded constant intercourse with its inhabitants and opportunities of travel among those who lived and worked far from the centres of population most affected by the growing influences of Western civilization, the impressions of this observer had long been felt, and with growing intensity. I shall attempt here, and in a subsequent article, to suggest some of the various and striking points of resemblance between the countries themselves and the character and customs of their peoples. The topics of interest that more naturally suggest themselves are mainly those connected with the scenery, "superstitions" and legends, and the social life and institutions common both to the Greece of the age of Pericles and the Japan of pre-Restoration days, that is, up to the middle of the nineteenth century.

In the first place, we notice how much the general geographical features of Japan have in common with those of ancient Hellas. In both countries there is the same combination of mountain, valley, and plain, a deeply indented coast-line with its bays, peninsulas, and islands off the coast. Few places inland are not comparatively near the mountains and none are really far away from the sea. In each case the configuration of the land conduced to the formation of small communities and to kindle a spirit of independence; for, just as Greece was, in a political sense, not one country but a collection of independent states, often quite small and always jealous of their own individuality, so it was with Feudal Japan, until the immense changes wrought by the recent growth of facilities for intercommunication between the inland and coastal provinces. Many of these provinces were inhabited by their own types of people, with marked differences of appearance, dialect, customs, and distinguishing characteristics. In the extreme south, Satsuma in many ways resembled Sparta with its Lacedaemonians, both in geographical inaccessibility and in aloofness of character, for both were stern, dour, unliterary, and somewhat harsh towards strangers. Again, the dullness of the Boeotians finds its counterpart in that of the inhabitants of one or two of the remoter provinces of northern Japan; while Athens, intensely social, literary, and comparatively liberal in its intercourse with the outer world, finds a parallel, *longo intervallo*, but not wholly a remote one, in the Kyoto of Tokugawa times.

FUJI-SAN.

This beautiful mountain peak has for the Japanese the sacred significance of the Olympus of Greece, and every summer it is visited by thousands of pilgrims.

In the case of each country the land was on all sides well protected and yet also open to the sea, with freedom of access for commerce, and the art of navigation was practised to a degree that bred a hardy and capable race of seafaring folk. In both the soil was only moderately fertile, generally speaking, a fact which led to the industry and comparative frugality of the majority of the inhabitants.

Neither country raised much cattle, and these were bred mainly for industrial uses; the extended seaboard yielded fish in great variety. An old Greek proverb about Cape Malea alludes to the perils of navigation in stormy weather round its cliffs—"When you have rounded Malea, forget your home." The counsel recalls the Japanese adage embodied in the title of a famous headland on the Sea of Japan—*Oya shiradzu Ko shiradzu*. "Here forget parents and children—and look after number one."

It is as true of the Japanese to-day as it was of the Greeks of old that a study of their natural surroundings is a clue to their history. What Professor Tozer stated in his "Geography of Greece" he would have written of Japan, and with equal truth, had he been in a position to do so—"The most characteristic feature of Greece is its mountains," for no less than seven-eighths of Japan is mountain land. He adds that "They ramify through the whole country and form a part of every view." When the poet Gray sang of Greece* he unwittingly laid his finger on one of the most distinctive features of the landscape of Japan also. We well know how much of the old Greek mythology gathers round the mountains of Hellas as the home of the gods and as the most frequent scenes of their intercourse with men; on them, in great measure, depends the character of the nation and of its several branches, and they constantly modify the course of historical events, especially of military operations. Moreover, not only did the diversities of landscape correspond to the ancient divisions of Greece but they were the cause of those divisions. No less true are these observations of the geographical features of many of the old provinces of Feudal Japan. To the student of Japanese historical geography, the stories of the internecine strife of the former Daimyo are full of vivid illustrations of the influence of the great mountain barriers in intensifying and perpetuating the distinctive characteristics of the several clans, and in effectively maintaining the political differences that so often marked them.

THE PILGRIMAGE BEGINS.

Clad in white robes symbolical of the purity required by the mountain deity, the pilgrims are here seen setting out for Fuji San, through one of the sacred gateways.

When we observe how eagerly the Greeks themselves seized upon any unusually striking piece of hill scenery and connected it with a legend or a shrine; how they took their loftiest mountain, broadbacked Olympus, for the home of the Gods, and found in the cliffs of Delphi a dwelling for their greatest oracle as well as a centre for their patriotism, we are looking upon scenes familiar to the Japanese for a thousand years and more of their history. To the far loftier and more beautiful sacred peak of Fuji-san, every summer sees its white-clad pilgrims toiling in their thousands, in sunshine or in storm, to worship at its summit shrine of nation-wide renown and sacredness; to the even still more holy fane of far-off Ise, in Yamato—the cradle of the race—the Emperor himself, or a chosen representative, alone may enter in, on occasions of national moment, to hold converse with the "Spirits of the Divine Ancestors" on behalf of his people. In these pious rites and in scores of others akin to them, we observe how close may be the likeness of the influence exerted by similar natural surroundings upon two separate peoples endowed with the common characteristics of a lively, artistic, and impressionable temperament.

It is impossible to read Sir James Frazer's illuminating book on "Studies in Greek Scenery, Legend and History" without feeling that had Pausanias been able to pursue a similar itinerary in the "Land of the Rising Sun" to that which he describes in Greece he would have furnished us with pictures of the scenery and observations on the folk-lore and legends of Japan that would, in a hundred separate instances, have been, *mutatis mutandis*, equally true of either of those beautiful lands. As one reads typical passages it is difficult to resist the feeling that they really form pages from the journals of a fellow-traveller in the romantic glens, and bright, sunny

*"Where each old poetic mountain
Inspiration breathes around."

SUN WORSHIP—
Just as the Greeks worshipped the sun god, so the Japanese of to-day bow their heads on the mountain tops, in adoration of the rising sun.

plains that border the Alpine regions of Central Japan.

Take, for example, a description of the Gorge of the Ladon up to the bridge of Spathari : " The river here forces its way along the bottom of a profound gorge hemmed in by high, wooded mountains, which, in places, descends in immense precipices, feathered with trees and bushes in their crevices, to the brink of the rapid stream. The narrow path runs high up on the right or northern side of the gorge, sometimes overhung by beetling crags and affording views, now grand, now almost appalling, down into the depths of the tremendous gorge, and across it to the high, wooded slopes or precipices on the further side." In almost identical terms I had already described the impressions of the walk up the romantic valley of Nakabusa, between the lofty forest-clad ridges of Ōtenjō and Ariake-san in the Northern Japanese Alps, first explored by my wife and myself in 1912.

Again, the picture of the Sanctuary of Poseidon in Calauria might well be a description of the exquisite and justly famed prospect from the spot known as *Fude sute-matsu* (between Yokohama and Kamakura), " the place where the painter threw away his brush in despair." " From the Sanctuary . . . at a height of about 600 feet above the sea, beautiful and wide prospects open between the wooded hills . . . We look down on the sea with its multitudinous bays, creeks, promontories, and islands stretched out before us and framed as in a picture between the pine-clad hills on either hand. A fitter home could hardly have been found for the Sea God, whose favourite tree, the pine, still mantles the greater part of the island."

The spring-time view of Taygetus across the Spartan vale recalls the distant prospect of the Northern Alps of Japan seen beyond the westward bounds of the Ōmachi plain, or that of the great serrated, snow-clad ridge of Shirane-san from the vineyards of Kofu. Nor need one ask for any closer description of the lovely lakes of Nishina on the way to the snowy fastnesses of Hakuba (" The White Horse Mountain ") than this :—" Where shall we look for the harmonious blending of grand mountains and sombre pine-forests with a still, pellucid, shallow, but not marshy lake, tufted with graceful water-plants, such as meets us in Stymphalus ? "

These parallels, naturally, must not be pressed too far or too closely. Nor should we forget that the mountain scenery of Japan to which reference has been made is on a much more imposing scale than that of Greece and is also probably more abundantly watered than was the case with Hellas, even in classical times. Nevertheless, as we remember the influence of man's environment upon his early religious beliefs and upon his outlook on nature, we shall expect to find, in these respects also, some points of close

—AND A MODERN OBSERVATORY.
In striking contrast with the pilgrim seen in the other photograph is this up-to-date observatory, which has been erected on Fuji-San 12,000 feet above the sea.

resemblance between the rural Japanese and those of the same class in ancient Greece. In this connexion Sir James Frazer shows us that the interest of Pausanias on his travels was mainly antiquarian and religious, and that what he describes is little more than the antiquities of the country and the religious traditions and ritual of the people. Many of the customs and legends he records are precisely what would have attracted his attention in similar surroundings and circumstances of even latter-day Japan. His picture of the vine-dressers running round the vineyards with the bleeding pieces of a *white* cock, in order to avert the black squall that comes crawling up across the bay, is a vivid reminder of the way that Japanese rustics were wont to sacrifice a white dog in the bed of a stream as a prophylactic against stormy weather. Many instances of "sympathetic magic" common to the two peoples are to be seen in the Greek priest "making rain" by dipping an oak branch in the waters of a spring rising on the holy mountain, or sacrificing for rain at the altars of Zeus and Hera, just as one may see in some secluded hamlet off the beaten track his Japanese counterpart offering his *amagoi* (intercessions for rain) at the village shrine in times of drought. Or, as the writer himself has at times himself witnessed, the incantations of bands of hunters on some lofty peak in Alpine Japan, as they light their bonfires, discharge their guns, and raise all possible din in the attempt to compel the Mountain Spirit to quench the desecrating flames and to silence the unhallowed uproar by the showers desired. Such rites as these were familiar to Pausanias as the practice of the peasants on Mount Ortholithion and elsewhere twenty centuries before we learn of their use in Japan to-day.

TO THE GOD OF WINDS.

Party of ship-wrecked Japanese sailors, each with bare scalp patch where the hair has been cut off as a votive offering to the God of Winds. Similarly the Greeks made offerings of hair in their temples.

Pausanias tells how the Troezenian maidens used, before marriage, to dedicate locks of their hair in the temple of the bachelor Hippolytus, and that the girls of Megara were wont to lay their shorn tresses on the grave of the virgin Iphinoë. It was a like sentiment that inspired the grateful woman whose own black tresses I saw laid before the shrine of the *genius loci* on the summit of the holy peak of Ontake, 10,000 feet above the sea, in fulfilment of a vow. During the erection of the great Buddhist temple of Higashi Hongwanji in Kyoto, I well remember the immense cables of hair, half a foot thick, by means of which the massive trunks of cryptomeria were dragged many scores of miles from the remote province whose devout daughters had thus made the most precious votive offering of which they were capable. In former times the shorn head of a woman proclaimed to the world the fact that she was either a widow or an adulteress, a circumstance which lends to such a gift an unwonted significance. Some years ago, when homeward bound from Japan, it was our good fortune to rescue from their sinking boat a crew of fishermen from one of the remote islands of western Japan, after a violent storm. On the top of the head of each man was a large and livid patch of scalp, laid bare by the knife with which he had cut off the hair to be thrown abroad as a votive offering to the God of Winds.

In conclusion, I may quote a last sentence from Sir James Fraser, who, describing the mountains of Greece and their different types of climber, remarks that "Truly the extremes of human nature sometimes jostle one another in the street."

In no country in the world is the last observation so widely and strikingly illustrated as in Japan to-day, where the *mikoshi*, the sacred cars in which the gods are periodically taken for a ceremonial airing, have been curtailed in size in order to avoid collision with the telegraph and telephone wires in the busy streets; or where, on the summit of sacred Fuji-san, one may turn, at early dawn, from the sight of a most up-to-date meteorological observatory and a post-office 12,000 feet above the sea, and watch an old white-clad pilgrim bowing his head and clapping his hands in adoration of the rising sun.

# The Origin of the Mycenae Tombs.

**By Stanley Casson, M.A.**

*Recent research on the Royal burial grounds at Mycenae, in Greece, has given rise to a new view of their history. The so-called "beehive" and "shaft" tombs, previously regarded as of separate dynasties, are now thought to be contemporary in origin. The problem is, however, highly controversial and further investigation will be required.*

RECENT discoveries in a royal tomb in the citadel of Mideia, a few miles from Mycenae, combined with some new views on the problems of the famous Shaft-Graves of the Kings of Mycenae put forward in a book just published by Sir Arthur Evans,* go far towards solving the many problems that surround the origin of the great treasure in gold and silver that was found at Mycenae. Sir Arthur proposes as his main thesis the startling view that the Shaft-Graves contain not primary but secondary interments, and that the primary burials were in the great "beehive" tombs, of which the so-called Treasury of Atreus is the best known. Hitherto the view generally held has been that the shaft-tombs on the acropolis of Mycenae of the seventeenth and sixteenth century B.C. were the royal interments, complete with all regalia and treasure, of one dynasty, and that the beehive tombs, which the Greeks called "treasuries," were the burial places, long since robbed, of a second and later dynasty. Sir Arthur now suggests that both types of tomb are contemporary, at the earlier date, and that the coffins, with their royal burials and the regalia that was placed on and in them, were removed soon after they had been placed in the beehive tombs (which had been built expressly to hold them) and placed in the shaft-graves on the acropolis. The reason for this removal was that the beehive tombs, being outside the acropolis, were in danger from some outside attack which may suddenly have become imminent, and that the new graves on the acropolis were protected by the construction at the same time of a new city wall.

FIG. 1.
THE QUEEN'S GOLD CUP (RESTORED).
Electrotype restoration of the gold cup newly discovered at Mideia, showing the *niello* design. The original cup is illustrated in Fig. 2.

The long and patient research of Sir Arthur Evans has put us in possession of many new facts. He has discovered, for instance, that the Mycenaean reliefs of bulls, now in the British Museum as part of the Elgin collection among the objects obtained by Lord Elgin from the Treasury of Atreus, are not only cut from Cretan gypsum but are actually copies of the Cretan frescoes outside the entrance gate at the Palace of Knossos. This almost startling addition to our knowledge of monuments long in our possession suggests how much can be learned by careful and scientific enquiry. For years the Elgin reliefs were catalogued as in limestone, but as soon as it was discovered that they were in gypsum a comparison with similar Cretan works was set on foot. The discovery that they resembled the Knossos paintings results in the conclusion that the Treasury of Atreus is contemporary with the Knossian palace decoration of the seventeenth century B.C., and that the architects responsible for it employed artists who perhaps worked in Crete itself upon the reliefs which were to adorn the entrance to the great tomb. Had they been cut by mainland artists or even by Cretans on the mainland they would certainly have been in limestone, as are the famous lions of the Lion Gate at Mycenae.

Sir Arthur has substantiated his theory of the general transference of the burials by a long series of arguments, showing in detail how the numerous gold ornaments of the Shaft-Graves were originally intended and designed for attachment to a wooden coffin which lay in state in the great treasury tombs. Thus the gold masks, for instance, which bear portraits of the deceased princes of Mycenae, are pierced at

* "The Shaft Graves and Beehive Tombs of Mycenae," 1929.

the corners for attachment by nails to a flat wooden surface. Many of the other objects of precious metal are clearly made with a similar intention in view. Furthermore, the various stone stelae found by Schliemann above the shaft-graves are identified by Evans now as belonging to the interior of the beehive tombs. His reasons are that similar stelae have been found in two beehive tombs elsewhere, forming part of the chapel-like portion of the tomb where ancestor-worship or similar rites were carried out.

The new conclusion that the objects in the Shaft-Graves came originally from the great beehive tombs has been borne out in a most striking way by the discovery of the beehive tomb at Mideia. Here, in the course of excavations carried out in 1926-1928 by Danish archaeologists, a beehive tomb of some size was discovered. In it were the undisturbed burials of a king, queen and princess. By the side of the queen were gold and silver cups, gems and other treasure. By the princess was a group of five fine gold-hilted daggers, an ostrich-egg cup mounted in gold (not unlike the ostrich mounted cups of Elizabethan times), and other objects among which many hundred gold embossed plaques were indistinguishable from the similar plaques from Mycenae. Of the cups found by the side of the king and queen two in gold were pre-eminently lovely. One, shown in Fig. 3, was as beautiful as anything from Mycenae, and in every way of the same date and style as the cups from the shaft-graves. It belongs to the seventeenth century B.C., and bears a design in relief showing the sea, viewed as it were, in section. Dolphins sport among the rocks at the upper level and below on the sea-bed are great octopuses whose tentacles spread gracefully over the whole design. The cup is a masterpiece from the hand of a master-goldsmith of Crete. The other cup shown in Figs. 1 and 2 is different in technique, in style and in shape from anything Cretan. It is shaped like a finger-bowl, and has a handle of a very unusual type on one side. The design is not in relief but in inlay of silver and bronze, a kind of *niello* work, and shows five heads of cattle rendered *en face*. Bands in silver run round the rim and below the design at the base. The handle is also worked with bands of silver let into the gold.

FIG. 2.
THE NEW DISCOVERY.
The Queen's gold cup, in which, notwithstanding decay, the original features are well-preserved, including the bulls' heads of the design.

FIG. 3.
THE KING'S GOLD CUP FROM MIDEIA.
This is in a better state of preservation than the other discovery, and its octopus design closely resembles that of cups found in the beehive tombs.

These cups, together with others less remarkable and some fine gems—including an agate one-and-a-half inches in diameter, one of the largest known Mycenaean intaglios—form a wealthy tomb-deposit of royalty comparable in every way with the splendours of the Shaft-Graves at Mycenae. The Mideia royalty, as befits a smaller dynasty of a subordinate city, are less wealthy and less impressive, but their property bears a similarity to that of Mycenae which is such as to make it certain that the culture of the two places is identical. But, in connexion with the new theories put forward by Sir Arthur Evans as to the original purpose of the shaft-graves and the beehive tombs, the Mideia beehive tomb seems to provide evidence that is conclusive. Here is an untouched beehive tomb and in it are objects of exactly the same type as those of the shaft-graves. In addition there were in the Mideia tomb stone stelae, similar to those found above the shaft-graves on the acropolis at Mycenae. Presumably the stelae at Mycenae had been removed from the beehive tomb and replaced above the shaft-graves, as memorials and to mark the identity of each grave.

The discoverer of the Mideia tomb dates it to the late fourteenth century B.C., so that it is later than those of

Mycenae. But the gold objects from Mideia are largely of the seventeenth or sixteenth century, and must have been heirlooms for several generations. The fact, however, that we now know the contents of a beehive tomb in the region of Mycenae is of the highest archaeological value, and will go far to solve the many outstanding problems of Mycenaean art and culture. The Mideia beehive tomb represents a period when, perhaps, the control of the Argive plain was no longer in the possession of the princes of Mycenae. Tiryns and Mideia, with smaller princes, had risen into power. But the old Mycenaean custom of burial of princes in cupola-shaped tombs had lasted. That the shaft-grave was not the usual type, but rather the exception, due to special circumstances, is emphasized by the discovery of the Mideia tomb, which admittedly belongs to a later date. At Mycenae the danger that attended the accumulation of enormous ancestral wealth in tombs not protected by the city walls compelled a change to other safer tombs. Later the danger seems to have passed, and the traditonal tomb is again possible.

### A Remarkable Cup.

Of the two cups from Mideia, the one with the cattle heads in inlay is remarkable for two things. It is not a definite Mycenaean shape nor yet a definite Cretan shape, although it can be called neither un-Cretan nor un-Mycenaean. The concentric bands of inlaid silver round the rim and the base link it with the simple decoration in this manner that belongs to pottery of north Balkan regions. The handle, however, is completely un-Minoan and un-Cretan and can be definitely identified with a type of handle found in Macedonia and in the north-west. It is a handle which can ultimately be traced to settlements of the Italian Bronze Age whence it came to the Balkans and the Danube valley. Here is no chance similarity; it is a feature which definitely associates this cup with the mainland and the north Balkans. Its decoration, in *niello*, or rather in actual inlay of silver and gold strips, is a technique of which the origin is uncertain and has not yet been fixed. But it is found largely in central Europe, and even reached Britain and Ireland, at a period in the Western Bronze Age when influences to these islands were coming mainly from central Europe. There is always the possibility that this particular technique went in the reverse direction, but it is remarkable that small rings of gold and silver combined, conceivably used as currency, are found in south-west England and Ireland. In the Museum at Dublin there are eight examples of striped *niello* rings, in the same fashion as the handle of this cup, with alternate silver and gold strips.

The design of heads of cattle is rendered in the Cretan manner, but these *bucrania* are here represented far more in the manner of Cretan goats' heads. The Cretan goat was not the goat usually found on the mainland, and so we have a mainland type rendered in the Cretan manner. Everything points, in fact, to this cup being a mainland product and a combination of Cretan and mainland elements. But that it contains a northern influence is quite certain. It is possible that it is later in date than the Octopus Cup, though there is no certain means of dating it.

### Startling Conclusions.

From the Mideia finds and the recent research of Sir Arthur Evans there has thus been much new light thrown upon the Royal Treasure of Mycenae. The establishment of the contemporary character of the two types of grave at Mycenae is the most surprising of all the conclusions arrived at. The view of the existence of two dynasties, separated by some two hundred years, was a view set forth as recently as 1923. It is now shown to be untenable by a scientific reconsideration of the evidence and by the new discoveries at Mideia. What we have still to find out is the reason for the moving of the old tomb furniture from the beehive to the shaft-graves.

The air has now been cleared for further research upon the same lines. Even as early as the late seventeenth or sixteenth century B.C. the influence of the north-west is apparent in some of the objects of the shaft-graves. Sir Arthur Evans has clearly called attention to it in his book. A partly European type of spearhead appears in the earliest shaft-grave instead of fully Cretan types. Amber is common while a bronze halberd with gold rivets, of a type best seen in Ireland, occurs also in this grave. Here the influence is purely Western, coming *via* the Adriatic. Thus, even at the beginning of its power Mycenae was in touch with many places north of the Greek mainland and far beyond the Mycenaean sphere of control. If the Cretan element was overwhelmingly predominant at Mycenae, yet the people of the mainland were trading with regions which are hardly at all represented by discoveries in Crete itself. Occasional imports and influences from remote regions thus reached the city even when the greater part of its products were of Cretan derivation. That these influences increased as time went on is certain; by the time the King and Queen of Mideia were interred the terms Mycenean and Cretan implied two very different phases of Bronze Age Civilization in Greece. It should be the task of future research to isolate the factors which brought about this difference.

# Chemistry in Ancient Persia.

**By E. J. Holmyard, M.A., M.Sc.**

*Head of the Science Department, Clifton College.*

*Recent research has thrown new light on an early Persian scientist whose significance can best be compared with that of the pioneer European chemist, Paracelsus. Among other posts he held that of chief physician to the hospital at Baghdad and wrote a treatise of outstanding merit on small-pox and measles.*

THE systematic use of chemistry as an aid to medicine began, in Europe, with that "fitful, strange, and moody" spirit Philippus Theophrastus Aureolus Bombastes Paracelsus von Hohenheim (1493-1541), who proclaimed himself the legitimate monarch of medicine, and assured the citizens of Basle that all universities, all writers put together, were less gifted than the hairs of his beard and of the crown of his head*. In spite of his arrogance and love of mystifying his fellows—for

> "Bumbastus kept a devil's bird
> Shut in the pummel of his sword,
> That taught him all the cunning pranks
> Of past and future mountebanks"—

Paracelsus performed the great service of drawing the attention of many chemists away from the phantasms of alchemy and directing it to the preparation and purification of drugs for use in medicine. He thus inaugurated the study of medical chemistry, or iatrochemistry, which formed the major portion of the science until the time of Boyle, and is still represented by our pharmacology and pharmaceutical chemistry.

Medicine and chemistry were, however, closely associated in still earlier times. Several chemists of Islam were physicians by profession, their interest in chemistry arising from the necessity they found of preparing their own drugs, or from their amateur researches in quest of the philosopher's stone. Conspicuous among these Muslim chemical physicians stands the great figure of Rhazes, who, though he differed from Bombastes as widely as possible in temperament and character, may well be called the Paracelsus of Persia, since he taught and practised the study of chemistry as a valuable aid to medicine.

### New Researches.

During the last few years, several important researches have been carried out upon his life and work—in this country by Colonel G. S. A. Ranking and the late Professor E. G. Browne, in Germany by Professor J. Ruska, and in India by Principal H. E. Stapleton of Calcutta—and we can now form a reasonably clear picture of the man and his achievements.

Abu Bakr Muhammad ibn Zakariyya al-Razi was born in 865 A.D. at the ancient town of Ray, the principal city of the north-east part of the Jibal province of Persia. It is from his birth at Ray that he was known as al-Razi, or "the man of Ray," a name which in Latin Europe underwent a modification into Rhazes, Rhases or Rhasis. In his early youth he gave his time to the study of music (upon which he wrote an encyclopaedic work), of philosophy and of logic. He sang well and became a skilful player upon the lute, but abandoned these accomplishments in after years on the grounds that music "proceeding from between moustaches and a beard" was seriously lacking in charm. As to philosophy, we are told that he did not fathom it, "nor apprehend its ultimate aim, so that his judgement was troubled and he adopted indefensible views, espoused heterodox doctrines, and criticized people whom he did not understand, and whose methods he did not follow."

### A Journey to Baghdad.

In his early thirties, he journeyed to Baghdad, where he heard of a wonderful cure that had just been effected at the Old Hospital, situated on the right branch of a canal in a suburb of the town known as Karkh. His interest thus aroused, he paid several visits to the Hospital, asking questions and taking notes, until in the end he decided to devote his life to the study of medicine. Muslim humour has provided us with an alternative story of the way in which he was led to this decision. Having already become fascinated by alchemy, the tale goes, Rhazes was one day carrying out certain experiments, in the course of which he accidentally inhaled some poisonous fumes. Upon going to a physician to be cured, he was amazed to be presented with a bill for £250. "I perceive," he said, "that here is the true art of alchemy or gold-making," and forthwith entered upon his medical training. Of this story, all that need be said is that our knowledge of Rhazes' character is sufficient to acquit him completely of any mercenary motive.

*Paracelsus is usually portrayed as bald and clean-shaven!

SYMBOLIC REPRESENTATION OF ALCHEMIST'S PROCESS.

Returning to his native town, Rhazes became a regular visitor to the local hospital, the dispenser at which was one of his personal friends. His diligence and intelligence were such that he soon surpassed his teachers, and after a short time he was appointed superintendent and chief physician at the Ray hospital. In addition to the heavy duties which these posts entailed, Rhazes had also to undertake the training of the medical students. In Muslim fashion, the master sat on the ground in the great, cool paved courtyard, with his pupils around him. In the innermost ring were the seniors, while the juniors sat beyond in an outer ring. When a patient came for treatment, he had first to describe his symptoms to the elementary students. If the latter understood the case, they prescribed for it, but if not, the patient was passed on to the "second year men." One may assume that there was very little beyond the powers of these young men, but if even they had to confess that they were baffled, Rhazes took the case in hand himself.

Such was the fame of Rhazes as an administrator and as a physician that, sometime during the reign of the Caliph Al-Muktafi (902-7 A.D.), he was offered, and accepted, the post of director and chief physician at the Hospital at Baghdad. How long he held this office we do not know, but he seems to have travelled a great deal, attending the Persian nobility and even Caliphs themselves. He always preferred Persia to Iraq, because it was his native country and his family still lived there. Towards the end of his life, he became blind, through his refusal to be operated on for cataract. His friends urged him to have recourse to a surgeon, but he steadfastly declined, remarking that he had already seen so much of the world that he was wearied of it. The occasion of the cataract, if we are to believe the testimony of another celebrated physician, Ibn Juljul, was an injury inflicted upon him by Al-Mansur, governor of Ray. Rhazes had written a book to establish the truth of the possibility of transmuting the base metals into gold, and travelled from Baghdad to Ray to present the book to Al-Mansur. The governor expressed his gratification, made Rhazes a handsome gift of £500—and ordered him to demonstrate an actual transmutation! Rhazes did his best, after vain attempts to evade the issue, but all to no purpose. Mansur then summoned him to his presence, and, having gravely reproached him for including deliberate falsehood in what purported

ANOTHER PAGE FROM ARABIC MANUSCRIPT.

to be a scientific treatise, struck him on the head with a whip. Cataract set in shortly afterwards, and finally Rhazes became totally blind. Of this story again we can say with no little confidence that, whatever the facts of the case, Rhazes at least was not guilty of wilful deceit of others, though he may have deceived himself.

Rhazes died in his native town on October 26th, 925 A.D., at the age of sixty years and two months. He is described as having been of a liberal and generous nature, courteous and affable to everyone, and exceedingly kind to the poor, upon whom he bestowed bountiful allowances and gratuitous medical attendance. The ablest physician of his age, Rhazes was a keen student of earlier authorities; "his chief anxiety and care was to study what the most famous learned men, such as Hippocrates and Galen, had written in their works, so that he made himself master of such knowledge as falls to the lot of very few

ARABIC ALCHEMIST'S "OVEN."

AN EARLY CHEMICAL DIAGRAM.

physicians." When not actively engaged in his practical or administrative business, he was continually reading, copying, or writing, and no doubt this excessive devotion to study was a contributory cause of his blindness.

The Muslim physicians were expert in the art of psychotherapy, and a story told of Rhazes in this connexion is amusing enough to be related here: A certain Emir was incapacited with severe rheumatism, which his own medical attendants were unable to cure. He therefore summoned Rhazes, who, after several methods of treatment had failed, finally said that he would try a new treatment but that it would cost the Emir his best horse and his best mule. The terms were accepted and the horse and mule were handed over to Rhazes, who thereupon took the Emir to a "Turkish" bath outside the city and went into the hot room with him. After a suitable time had elapsed, during which draughts and douches were administered to the patient, Rhazes went out, dressed, and returned with a knife in his hand. The startled Emir was amazed to hear a torrent of abuse pouring from the lips of the eminent physician, but when Rhazes at length brought matters to a climax by threatening to kill him, the Emir's fear and anger knew no bounds. He sprang to his feet in order to summon the guard—forgetting all about his rheumatism—but Rhazes had fled to the outer door of the bath, where his servant was waiting with horse

and mule. They did not stay their flight until they were over the frontier. Rhazes afterwards wrote and explained that his provocative words and acts were designed as a part of the treatment, and the Emir, who had indeed completely shaken off his pains, had grace enough to see the humour of the situation. He rewarded his ingenious healer with many rich presents and assigned him a yearly pension of £1,000 and two hundred ass-loads of corn.

### First Classifications.

Rhazes is of exceptional importance in the history of chemistry, since in his books " we find for the first time a systematic classification of carefully observed and verified facts regarding chemical substances, reactions and apparatus, described in language almost entirely free from the usual alchemical mysticism and ambiguity." While he perhaps never attained to the genius of his great pre lecessor Geber—of whom he always speaks with admiration and reverence—his clear and orderly habit of thought and expression made his work easily intelligible and of permanent value. His scheme of classification of the substances used in chemistry shows a sound chemical insight. It is as follows :

CHEMICAL SUBSTANCES.

| Mineral. | Vegetable. (rarely used) | Animal. | Derivative. |
|---|---|---|---|
| | | Hair | Litharge |
| | | Skull | Red lead (Tin oxide) |
| | | Brains | Verdigris |
| | | Bile | Burnt Copper (CuO) |
| | | Blood | Tutia (ZnO) |
| | | Milk | Rust of Iron |
| | | Urine | Smithy scales ($Fe_3O_4$) |
| | | Eggs | Cinnabar |
| | | Mother of Pearl | White arsenic |
| | | Horn | Glass-dross ($CaSiO_3$ ?) |
| | | | Caustic soda |
| | | | etc. |

| *Spirits.* *e.g.* | *Bodies.* *i.e.* | *Stones.* *e.g.* | *Vitriols.* | *Boraces.* | *Salts.* |
|---|---|---|---|---|---|
| Mercury | Metals | Pyrites | Green | Natron | Sweet |
| Orpiment | | Azurite | White | Borax | Bitter |
| Sal-ammoniac | | Malachite | Yellow | etc. | Rock |
| Sulphur | | Haematite | Red | | Qali |
| | | Mica | etc. | | Slaked lime |
| | | Gypsum | | | etc. |
| | | etc. | | | |

Rhazes gives also a list of the apparatus used in chemistry. This consists of two classes—instruments used for melting metals, and those used for the manipulation of substances generally. In the first class were included a blacksmith's hearth, crucible, descensory, tongs, and a semi-cylindrical iron mould, while the second class included :

| | |
|---|---|
| Cucurbite | Water-bath |
| Alembic | Large oven |
| Receiving flask | Hair-cloth |
| Aludel | Filter of linen |
| Beakers | Cylindrical stove |
| Glass Cups | Potter's kiln |
| Shallow iron pan | Chafing-dish |
| Sieve | Mortar |
| Heating-lamps | Flat stone mortar |
| Flasks | Stone roller |
| Phials | Round mould |
| Cauldron | Glass funnel |
| Sand-bath | Dish |

It will be observed that the list was comprehensive, but Rhazes completes the subject by giving details of making composite pieces of apparatus, and in general provides the same kind of information as is to be found nowadays in manuals of laboratory arts.

Like Geber, Rhazes was a firm believer in the possibility of transmutation, and Stapleton describes his scheme of procedure approximately as follows. The first stage consisted in the cleansing and purification of the substances employed, by means of distillation, calcination, amalgamation, sublimation and other processes. Having freed the crude materials from their impurities, the next step was to reduce them to an easily fusible condition. This was done by an operation known as *ceration*, which resulted in a product which readily melted, without any evolution of fumes, when dropped upon a heated metal plate.

### The Famous Elixir.

The next step was to bring the " cerated " products to a further state of disintegration by the process of solution. The solutions of different substances, suitably chosen in proportion to the amount of " bodies," " spirits," etc., they were supposed to possess, were brought together by the process of combination. Finally the combined solutions underwent the process of coagulation or solidification, the product which it was hoped would result being the Elixir. This, as is generally known, was a substance of which a small quantity, when projected upon a larger quantity of baser metal, would convert the latter into silver or gold.

From a general study of his chemical works, Stapleton says that henceforward Rhazes must be accepted as one of the most remarkable seekers after knowledge that the world has ever seen—not only " unique in his age and unequalled in his time," but

without a peer until modern science began to dawn in Europe with Galileo and Robert Boyle. The evidence of his passion for objective truth that is furnished by his chemical writings, as well as the genius shown by the wide range of books he wrote on other subjects, force us to the conclusion that—with the possible exception of his acknowledged master, Geber—Rhazes was the most noteworthy intellectual follower of the Greek philosophers of the seventh to fourth centuries B.C. that mankind produced for nineteen hundred years after the death of Aristotle. "His supreme merit lay in his rejection of magical and astrological practices, and adherence to nothing that could not be proved, by experiment and test, to be actual fact."

Of Rhazes' numerous books and monographs on medical subjects this is not the place to speak, but it may be mentioned that he wrote a celebrated treatise on small-pox and measles, which "on every hand and with justice is regarded as an ornament to the medical literature of the Arabs." His most important text-book of medicine was called the *Hawi* or *Continens*, which has never been published in the original and of which no complete manuscript exists. Even in the tenth century, the famous physician known to the West as Haly Abbas (Ali ibn al-Abbas), could discover only two complete copies. In its Latin dress, the *Continens* was published as early as 1486, at Brescia, and formed one of the chief handbooks of early European medicine.

In spite of his great attainments, Rhazes was a modest man, as the following anecdote may serve to show. When walking with a party of his pupils one day, Rhazes met a madman. Now the madman would gaze at none of the pupils, but only at the master himself. Upon returning to his house, Rhazes ordered them to prepare for him a decotion of dodder, which Dioscorides recommends as a cure for mental diseases, and much to everyone's surprise, when it was ready he drank it. His pupils enquired why he drank it, to which question he replied that as the madman had gazed and smiled upon him, he must have perceived in him some trace of his own madness, for "birds of a feather flock together."

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# The Curvature of Space.

**By Edwin P. Hubble.**

*Mount Wilson Observatory (Carnegie Institution).*

*At a recent meeting of the American Association for the Advancement of Science, Mr. Milton Humason and Dr. Francis Pease of the Mount Wilson Observatory described important new observations of the spectra of certain very remote nebulae. Dr. Hubble, the well-known astronomer, here discusses the significant features of this study and suggests that it may have a bearing upon Einstein's conception of the curvature of space.*

APPARENT velocities of nebulae, ranging from 3,100 to 4,900 miles per second, have been announced by Humason and Pease of the Mount Wilson Observatory. These velocities are believed to be illusory—to represent not actual motions but distortions in light waves coming from distant sources, due to a curvature of space.

Since the surface of the earth has a definite area but no boundaries, it must necessarily be curved. This is a trivial example, but it offers a simple analogy. If the universe has a finite volume but no boundaries, as is indicated by the theory of relativity, then space itself must be curved. The universe is so large, however, that the curvature in a relatively small volume may be inappreciable, and therefore an investigation of the matter demands observations over as large a volume as possible. This is what Mr. Humason is attempting in his study of nebulae with the 100-inch reflector. The telescope is the largest in existence; nebulae are the largest and brightest objects in the sky, hence they can be observed at the greatest distances. The method employed is to analyse the light of nebulae with a spectrograph and to study the photographs of the spectra thus obtained. Even the brightest of the nebulae require long exposures with the spectrograph and for the faintest that can be studied, the exposures may run into weeks. The time, however, is well spent, for it furnishes invaluable information about regions of the universe that are vastly remote.

CURIOSITIES OF THE AMAZON VALLEY.

In addition to the Devil Fish (6), the photographs above show (1) Chamelion, *Ameiva Leucostigna*, (2) Vampire Bat, (3) a pair of Toucans, (4) Anaconda snake or "water serpent," (5) the Sloth.

Spectra of some forty odd of the brighter and hence nearer nebulae had previously been accumulated, largely through the efforts of Dr. Slipher at the Lowell Observatory. The various lines of these spectra were almost invariably shifted to the red of their normal positions and these shifts were interpreted as velocities in the line of sight, away from the earth. Such shifts, either toward the red or toward the blue, are constantly being observed and studied in the spectra of stars where they are known to be caused by motion in the line of sight. Among the nebulae, however, the shifts were almost invariably toward the red, and the corresponding velocities of recession averaged many times those found for the stars. The greatest velocity found was about 1,100 miles per second.

### 7,000,000 Light Years.

Recently, after the distances of many nebulae had been determined, it was discovered that these velocities of recession were correlated with the distances—the farther away a nebula is, the faster it appears to be travelling, always away from the observer. The few velocities of approach were very small and were restricted to the nearest nebulae. The reliable data were limited to nebulae not more than 7,000,000 light years from the earth, and indicated that for every million light years of distance there was a shift to the red in the spectra amounting to a velocity of nearly 100 miles per second. The outstanding velocity of 1,100 miles per second belongs to a nebula whose distance is not definitely known except in so far as is indicated by the shift in the spectrum.

The new investigations furnish tests of this correlation among much more distant objects. Humason concentrated on clusters of nebulae—huge organizations averaging more than a million light years in diameter and each containing several hundred individual nebulae.

The first definite results, reported a few months ago, gave a red shift in the spectra of N. G. C. 7619, the brightest nebulae in a cluster in the constellation of Pegasus, corresponding to a velocity of 2,400 miles per second away from the earth. The cluster appears to be at a distance of the order of 25,000,000 light years, hence the relation between distance and velocity agrees with that found among the nearer nebulae.

The new results, just announced at the meeting of the Pacific Division of the American Association for the Advancement of Science, concern three nebulae in a smaller cluster in the constellation of Coma Berenices, about four degrees from the pole of the Milky Way. The distance of the cluster is of the order of 50,000,000 light years, or twice that of the cluster in Pegasus. Spectra were obtained by Humason and Pease. Although the nebulae are among the brightest in the cluster they appear so faint that the exposures ran up as high as forty hours. A study of the spectra by Humason indicated red shifts corresponding to velocities away from the earth of 4,900 miles per second for N. G. C. 4860, 4,600 miles for N. G. C. 4853, and 3,100 miles for N. G. C. 4865.

It is reasonable to assume that the two former are bright nebulae belonging to the cluster and that the third, N. G. C. 4865, is a fainter nebula much nearer the earth. On this assumption the mean of the two larger velocities, something more than 4,700 miles per second, represents the velocity shift at the distance of the cluster. This interpretation would be a remarkable confirmation of the correlation previously found. It would justify the use of the red shift in spectra of isolated nebulae as indications of distance and would furnish definite quantitative data for a discussion of the curvature of space.

There is still the possibility that the third nebula really belongs to the cluster. In that case the significance of the correlation would have to be thoroughly re-examined for the range in the three velocities, 1,800 miles per second, is much greater than we have any present reason to expect in a single cluster. Fortunately, the 100-inch reflector is sufficiently powerful to register the spectra of at least ten or fifteen other nebulae in the cluster, and when these are obtained (in the course of the next two years) it will be possible to tell whether N. G. C. 4865 is one of their family or a distant stranger who happens to be in the line of sight. Regardless of this uncertainty, however, the observations are highly important in their own right. Mr. Humason has brought phenomena of a new order to the attention of physical science. The data, moreover, concern very remote, almost unknown, regions of space, and they appear to offer observational evidence on the structure of the universe itself.

## The Devil Fish.

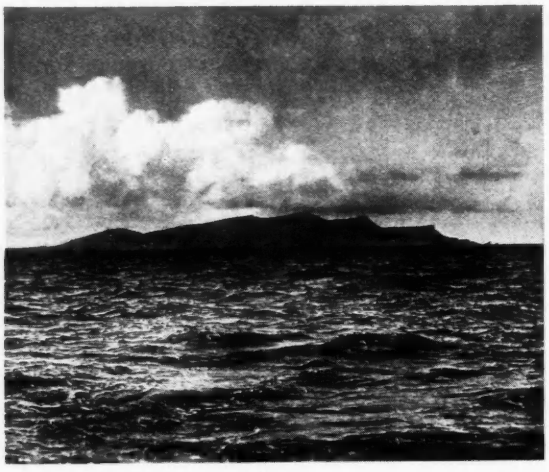
THE remarkable photograph opposite of a Devil Fish, taken this summer by a traveller on the Amazon and sent to the Editor by the Booth Line, shows the fierce features of a fish, which, though small, is dreaded far more than the alligator. Having the name *Piranha*, it is specially attracted by blood, with the result that a wounded bird or animal which happens to fall into the water is bitten to pieces by scores of these fish before it can reach the bank. The Devil Fish is eighteen inches in length and weighs four pounds.

# Scotland's Remotest Island.

By John Gladstone.

*With the object of making the first collection of plants in Foula, the writer recently visited this lonely island off the coast of Shetland. It is inhabited by a primitive community whose ancient customs are gradually disappearing, but many plant names survive since the days when Norse was the language of the people.*

THE island of Foula, sixteen miles west of the mainland of Shetland and twenty miles from the nearest harbour, can make out a good claim to be the most inaccessible island off the Scottish coast. Foula's only rival in this singular competition would be St. Kilda, an island which, although twice as far from land, is in closer touch with Great Britain. It has always been a far-off land even to the Shetlanders. Just as St. Kilda was the Hirta or Earth—implying the other land—of the men of the Outer Hebrides, so, if Shetland was Agricola's Thule, Foula was his Ultima Thule. Another significant name given to Foula was Uttrey or Uttrie, the Uttermost Isle. Foula, however, has the additional disadvantage of having no harbour at all. It is difficult even in the calmest weather for boats to anchor off the island for any length of time. Consequently, while St. Kilda depends on benevolent trawlers and tourist steamers to bring out her mails and stores, the inhabitants of Foula have to go out themselves to fetch these necessaries.



FOULA.

A view of Foula taken from about five miles to the east of the island, showing the small amount of lowland (Photographs by Professor A. H. S. Holbourn).

The little motor "mail-boat" from Foula is due to arrive in Walls, the nearest village on the Shetland mainland, every Monday in summer and every other Monday in winter. But the islanders dare not venture on their twenty mile trip if the weather is unfavourable. A few years ago she was unable to put out from Foula for thirteen weeks, and a delay of three weeks or so in winter is not unusual. When the islanders cannot get back from Walls, they stay in a little hut they have built till the weather changes. These conditions make it extremely difficult for tourists to find their way to the island.

When I set out to visit Foula, I had been warned that there was no house on the island that had room for strangers; but that the "laird" might possibly be able to help me. My only hope of getting a bed—and I could not leave the island for at least a week—was to approach Professor Holbourn, the owner of the island. I had no difficulty in picking him out among the crowd on the pier or in explaining my difficulties. When I told him that I had a commission to make the first collection of plants from the island he very kindly took me up to his house and lodged me for a fortnight. I do not say that every traveller to Foula would be in the same position as myself. The school teacher, who usually gives a visitor a room, was away at the time; arrangements might be made by post with one of the islanders if the letter was sent a good three weeks beforehand.

The island of Foula—or Fugley to use its older spelling and pronunciation—is three and a half miles long and two and a half miles broad. It has an area of four thousand acres; three thousand five hundred acres are rough grazing and the remaining five hundred are enclosed and were at one time cultivated. The highest point of the island is 1,376 feet. It was thought up to last year that Foula was four feet higher than St. Kilda, but Mr. Mathieson, who completed the Ordnance Survey of Great Britain by surveying St. Kilda last year, found the true altitude of Conacher on St. Kilda to be 1,396 feet, thus defeating Foula by twenty feet. Neither can Foula's claim to have the highest cliff in the British Isles be allowed; for St. Kilda has a cliff 1,350 feet high.

There is no doubt, however, that the Foula cliffs (the highest is 1,220 feet) can be seen to better advantage than those of St. Kilda and are more impressive by reason of their straight lines and red colour.

We can hardly expect the customs, occupations and aspirations of the inhabitants of Foula to be those of the twentieth century. Indeed, many traces of the primitive self-supporting society have remained. The men still do without outside assistance any work which has to be done on the island. They build their own boats, and do their own carpentry and shoemaking. They even make their spirit-levels, gauges, saws and planes. Fifty years ago all the clothes worn on the island were made at home; lately, however, they have found it more convenient to buy their cloth in Shetland and make it up at home.

Perhaps the most interesting craft of all is house-building. All the older men on the island know how to build a house; indeed, many have built the houses they live in. They quarried the stone from the hills near by and carried it down to the proposed site.

GAADA STAC.
This rock of curious shape, beaten by storm and weather, stands 126 feet high, and is typical of the rocky coast of the island.

A ROCK-BOUND INLET.
This view of the "south end" of the island shows a few acres of settled land, the building on the left being the Established Church.

The stones were put together without mortar, a method which allowed the damp instead of collecting in the wall to soak through to the ground. Finally the house was thatched with a grass found on the island. A hundred years ago the houses were built in a square block with the living room in the middle and a barn and a shed for beasts on either side. Fifty years ago this plan was discarded; houses built since from about 1870 onwards have had their sheds built behind or alongside the house. In half the houses on the island the peat fire still burns in the middle of the floor and the smoke escapes through an opening in the roof, leaving a thick deposit of black soot on the rafters. Many houses have recently been altered by their owners; grates and wooden floors have been put in and a felt or slate roof has been substituted for thatch. There are only five two-storied houses on the island.

Although there is nothing to mark their sites, the positions of ancient churches and graveyards are known. The only other buildings the island possesses are seven water mills, in which bere and oats are ground between two stones, turned from below by means of a vertical shaft attached to a small wooden water wheel. Four of these mills are in an excellent state of preservation and are still in use. A hundred years ago, when the population of the island was twice as large as it is to-day, enough corn was ground at these mills to feed both the people and their animals. But this is no longer the case; each year a considerable amount of meal is bought. The reasons for this change are not far to seek: the land is getting exhausted; crops are taken year after year off the same piece of ground; the only manure used is turf which has served as cow's bedding; new ground is never broken up and deserted crofts are allowed to

THE CROFTER AT HOME.

In the centre of the croft interior the peat fire is seen on the primitive hearth. The smoke escapes from a hole in the roof.

revert to uselessness. The islanders themselves would admit that they have less energy than their forefathers. A hundred years ago a young man, leaving his father's house to set up for himself, would "break out" a new croft; but now he goes on cultivating the same piece of land or deserts Foula for the mainland. Potatoes have always done well on the island; swedes—first planted in little round enclosures (called Planti crubs) to protect them from the wind—are afterwards transferred to the open ground where they are usually successful.

The money which enables the Foula men to buy their meal comes to the island mainly in exchange for wool and knitted goods. There must be about two thousand sheep on the island; but no stranger, not even the laird, will ever know the exact number. The reason is that the Crofters Act of 1887 *inter alia* fixed the number of sheep which each man could keep on the island. Soon this number was exceeded; and there is to-day no effective check on the number of sheep he may have on the hill. The markings of the sheep are known only to the islanders; they would never let a stranger into their secret. The overcrowding, however, does not seem to have had a bad effect on the sheep, which are of the usual mixed Shetland breed. Owing to the precipitous country they inhabit, the sheep are thinner, longer legged and faster runners than the Shetland sheep. It is for this reason that the islanders have never worked them with dogs. They say that the sheep would be terrified when they saw a dog and would immediately make for the cliffs.

Before their wool can be removed the sheep have to be rounded up and chased into a pen. I was fortunate to be able to help the agile young population in three chases which were remarkably successful; on one occasion as many as fifty sheep were chased for over a mile. These "rooings," as they are called, usually take place in July, and there are often as many as a dozen in the year. Last July was wet and by August many ewes had shed their wool on the hill. This has made the people see that their methods are out of date, and may lead, if they can come to some collective agreement, to the substitution of sheep dogs for sheep girls. The flock safely in the pen, they are removed one by one to have their wool "rooed." This operation consists in removing the fleece by plucking it by hand, or occasionally, if the wool is very thick, by cutting it with a short sharp knife. Shearing is said to spoil the sheeps' wool, and so long as the breed of sheep remains unchanged, will never be substituted for rooing. This year the greater part of the wool was exported at once, but the women are keen to knit, and would do so were a market for their goods assured.

Cows are kept by every crofter on the island, but because of the difficulties and uncertainties of transport, there can be little export trade. The laird

THE CROFTER AT WORK.

Peat, the principal fuel on the island, has to be carried to the croft in baskets.

has a few Shetland ponies on the north end of the island. Pigs were once kept and could be profitably reintroduced. Rabbits were brought to the island some sixty years ago and have increased enormously; nine out of every ten, however, are diseased and unfit for food. Foula, like St. Kilda, boasts a unique variety of mouse, the *Mus Thulensis*.

The botany of Foula is interesting chiefly from the point of plant distribution in remote islands. Most of the common meadow plants are found in the sheltered low ground; but the hill plants—with the exception of the rare *Cornus suecica Linn.*—are disappointing. This can be accounted for by the fact that there is no sheltered gully or stream above a thousand feet on the south side of the island; all the rocky and wet ground feels the full force of the northerly winds. I was able to collect one hundred and fifty varieties of plants, including grasses and ferns; also an interesting list of local names for plants, many having their origin in the days when Norse was the language of the island.

FOULA'S RUGGED COAST.

Another view of the Gaada Stac and rocks off Foula, showing the treacherous nature of the coastal waters.

There is no doubt that at one time Foula was covered with trees. The islanders have a tradition that their ancestors, after forcing their way on to the island, burnt down the primeval forest in order to prevent the inhabitants using it for ambush. Roots of birch and juniper have in fact been found in the peat at a depth of some six feet. Tree planting experiments, however, in recent years have all failed. About 1904 many varieties of trees and shrubs were planted; none succeeded in growing any higher than the dyke which afforded them protection. I think that had the trees been planted together—so that they could have given each other shelter—the experiment would have been more successful.

To the naturalist the birds of Foula are the outstanding interest of the island. Their numbers and their habits are sure to be noticed by the ordinary visitor; while the rarity of some of the birds seen in large numbers makes them all the more interesting to the ornithologist. Foula contains the largest breeding ground in Great Britain of the great skua or bonxie (*Stercorarius Skua Skua*); the Arctic or "Allen Richardson" skua (*Stercorarius parasiticus*), known on the island as the "aulin" or "scootie aulin," breeds in large numbers on the low ground. Foula is said to possess one of the finest colonies of kittiwakes in Great Britain. Rock-doves, merlins, shags, black guillemots, storm petrels and Manx shearwaters are among the uncommon birds which breed on the island. There are also innumerable razorbills, puffins, terns, gulls and fulmars. Before the war the peregrine falcon and the white-tailed eagle used to breed on the cliffs.

Each species of bird owns a portion of the island into which birds of another kind venture at their peril. The bonxies and the aulins are especially particular about the limits of their respective territories, and an invader is seldom allowed to pass unnoticed. The bonxies rule the high ground above five hundred feet, while the aulins keep to the inland peat-haggs. They have each a loch of their own on which trespassing is strictly forbidden. An aulin who appeared at Overfandel Loch, the property of the bonxies, would be warned off by perhaps fifteen to twenty bonxies. It is even dangerous for people to wander about the hills in the breeding season, for both the bonxie and the aulin will not hesitate to attack any creature which comes within thirty yards of her eggs or young ones.

The largest loch on the island is used exclusively by kittiwakes, who come to it on a continuous stream from the north and the south of the island. To reach it they have to fly over the aulins' territory; they always take care to form themselves into groups before they dare to pass over the hostile country. If a kittiwake goes over alone he is sure to be attacked; and the immediate purpose of the attack is particularly unpleasant; two aulins will give chase until it vomits its food, this they catch and devour in mid-air! The Foula men used to be very good climbers; the Kame, the great cliff of the island, has been climbed from top to bottom. But since birds' eggs are no longer eaten and the trade in feathers has died away, the need for climbing has gone.

Before the war fishing was the islanders' main source of income. Now, for reasons not known to

the laird, no fish are exported. The people say that the trawlers have spoiled the fishing round the island by destroying the spawning beds. The " haaf " or deep-sea fishing is less productive than it used to be ; but line fishing for haddocks, gurnards and " piltocks " (two-year-old coal-fish) is still carried on. The islanders do not fry their fish and eat them fresh ; they are salted and hung up in the houses to smoke and are eaten when other food is scarce. Fishing can only be carried on round Foula in the finest weather. Foula possesses no lighthouse or foghorn ; the tide races, called rösts or strems, which surround the island, are some of the most dangerous in Shetland. The *Oceanic* was lost just after the outbreak of war in 1914 about four miles from land not far from the Hoevdi Gründ, the shallowest point of the dangerous Foula shoal.

### Ancient Ballads.

The islanders have a remarkable gift of story telling. The traditions of the island have been handed down from father to son ; every man's ancestry is known for six or seven generations back. Some very interesting border ballads and pre-reformation hymns have found their way on to the island, probably when the English language supplanted the Norse a century or so ago. Professor Holbourn is at present engaged in writing down their words and music. The discovery of ballads in out-of-the-way places is not very surprising ; from the border where they were composed they have been taken wherever English is spoken. Some of our most beautiful ballads have been discovered in the Blue Mountains (U.S.A.), whither they had been taken by settlers. In Foula we have another such treasure trove, which is only now being investigated. Professor Holbourn has also made up for the deficiency in local ballads by putting into ballad verse stories which the islanders have told him.

Foula long remained isolated with her own customs, traditions, and—until the beginning of the last century—her Norse dialect. Her inhabitants had little communication with Shetland and seldom saw a stranger. But recently they have discovered that across the sea there are other lands ; men have left the island and the population has decreased. Only a quarter of a century ago there were 240 people on the island ; last year the population only numbered 147. The tendency is for the younger men to leave the island whenever they get a chance, being made increasingly dissatisfied with their life on the island by those who have emigrated and come home again. The higher standard of living which has unconsciously crept into the island has made life difficult for men who find it impossible to increase their incomes. The older men on the island were proud of making everything themselves. The strongest and most resourceful man built the best house ; now, however, the man with the most money builds the best house.

Government interference has done much to change the ambitions of the islanders. It is questionable whether before one of them was made sub-inspector of the poor there was greater suffering among those who had become too old to cultivate their crofts. Old age came to all in turn, and all were prepared to meet it. The younger men helped those older than themselves, just as these had helped their grandfathers, never asking for any money in return. Now older men get the old age pension and their neighbours feel that they are able to pay for any work done for them. At the same time the feeling that money is useful—a thing to obtain if possible—has come in ; work for a fixed sum of money will soon take the place of voluntary labour by those who are able to do the work. Sheep rooing, where the girls do the chasing just because it amuses them to run over the hills and where the men help to roo their neighbours' sheep, will disappear, and what the economists call the " division of labour " will come in ; shepherds and shearers will emerge from men who are at present able to do everything.

### Disenchantment.

As soon as the inhabitants of an isolated island like Foula become dependent on the outside world, on pensions, on local government, on communication with the mainland, and above all on money, the equilibrium of a primitive community is upset. They feel that instead of just living they must make money ; they are surprised to find that money cannot be made without specialized forms of work. They do not realize that the difficulty of communication inevitably precludes any method of making money that has been adopted on the mainland of Shetland.

Supposing the entire population of Foula were to die off and the question of resettlement were to come up—there would be no movement to resettle Foula. Here we are at the bottom of our problem. Foula was no doubt a charming little island for the Viking settler ; but it can only survive under the primitive form of community which the people themselves have evolved. As soon as the necessity of making money is felt enter a new set of values—and disenchantment. I can foresee no " commercial prosperity " for the island of Foula ; depopulation and the eventual abandonment of the island are sure to come.

# Correspondence.

## "DO DREAMS COME TRUE?"

*To the Editor of* DISCOVERY.

SIR,

I have read with very great interest Dr. Russell's review of "An Experiment with Time," by Mr. J. W. Dunne, in *Discovery* for May, and beg leave to give here my experiences on the subject. I hope they will provide more material both to Mr. Dunne and Dr. Russell for drawing their own conclusions.

(1) In March, 1909, I appeared in the Matriculation Examination of the Punjab University. My attention must have been concentrated on the result, but being in an out-of-the-way village I had absolutely no means of knowing anything of the result and the current rumours about it. One day I was sleeping in my house when somebody in my dream told me that the result was out. It was just about two in the afternoon and I got up feeling very anxious. Being at a distance of about 112 miles from the university, and some miles from the nearest telegraph or post office, I could do nothing to find out whether the result was actually out or not. The next day I received an authentic message that I was one of the successful candidates, and a few days afterwards came to know that the statement had been posted outside the university exactly at 2 p.m.

(2) In 1914 when I was an M.Sc. student at Lahore, a friend of mine was living in the same room with me, who had a brother in the Forest Department in Madras—at a distance of about 1,500 miles from Lahore. Mr. Shiv Lal expressed his anxiety about his brother, saying that he had written to him several times and had received no reply. One night I saw his brother in a dream, though I had not seen the gentleman before. He told me that he had been out on tour in his range. Shiv Lal's letters remained at Headquarters and, as a matter of fact, he had received them all at once on coming back from a long tour. Next morning Shiv Lal talked about his brother again, and I said he would receive a letter that day containing the above remarks. When the mail came he did receive a letter containing exactly the same information.

(3) In 1915 I was student superintendent of one of the branch hostels of Government College, Lahore. Mr. Tomlinson, Professor of English, was warden of the hostel, and one night in a dream he took me aside and asked me to censor the mail of all boarders before it was distributed. Large numbers of copies of an anti-Government paper called *Liberty* he said were being distributed among students, from some unknown centre by some unknown persons. These he said should not reach the students. Next morning I related this dream to a friend of mine (named S. A. Khan, now a district magistrate in Bihar and Orissa), and that very day at about 2-3 p.m. Mr. Tomlinson's peon came to say that the warden wanted to see me. On seeing Mr. Tomlinson I received exactly the same instructions as I had received from him in my dream. I related my dream to him and he was very much surprised. I might add that before the dream I had never spoken with anybody about *Liberty*.

I have selected only a few dreams out of many which have come out to be true about future events. In No. 1 it can be said that as my attention was very much concentrated on my result I dreamt of it, and that it was exactly at the time when the result was being posted was a mere matter of chance. In No. 2 one could say that the only reasonable way of explaining the silence of Mr. Shiv Lal's brother was the one in which I dreamt of it. As regards No. 3, I might have heard of *Liberty* and the measures which could be taken in an educational institution, but they were all so accurate and exact that one cannot help placing them in a class by themselves. From my own experience I do not doubt that sometimes one does see in dreams events that are yet to come. There may be difference in details but the general trend of the information received in a dream is correct. One may or may not get an exact photograph, but one may see a negative instead of a positive, so to say.

As to how it happens I leave it to Dr. Russell and Mr. Dunne to decide, but I have my own way of explaining the phenomenon. From the spiritualistic point of view body and soul are quite separate in their identity. Body has its limitations as regards time and space, but the soul has no such limitations. . . . It may be possible to explain the phenomenon on the basis of the known laws of science, it may not be possible at all. The human mind is too busy with the materialistic side of things, and who knows there may be a spiritual side as well.

SANDAR MOHAMMAD.
Assistant Professor of Chemistry,
Lyallpur, India. Punjab Agricultural College.

## THE MULL VOLCANO.

*To the Editor of* DISCOVERY.

SIR,

My attention has just been drawn to Professor Gregory's interesting article on "The New Eruption of Etna." The writer draws a comparison between Etna and the more ancient volcanoes of Mull and Skye. He instances in his support the work of Judd, and states that the more recent Geological Survey work has "fully confirmed Judd's view that the mountains of each island include the central core of a great volcano, surrounded by radial lava flows of basalt."

As regards the island of Mull, this statement is more definite than the view expressed by Mr. Bailey, who was editor of, and largely responsible for, the contents of the Mull Survey Memoir ("Tertiary and Post-Tertiary Geology of Mull," *Mem. Geol. Survey*, 1924). Mr. Bailey "is doubtful whether the lavas still spared by erosion are not, in the main, the products of a central volcano." The eruption of these lavas mainly from fissures, unconnected with a central cone, as supposed by Sir Archibald Geikie, is still a possible alternative. On the whole the evidence, dispersed throughout the memoir, may favour central eruption, but there is far from being any definite proof of such a mode of origin.

Edinburgh. E. M. ANDERSON.

Professor Gregory writes :—

"The theory that the lava sheets of Mull were due to fissure eruptions was based on the view that these sheets were fed by the dykes. The proof by the Survey, to which Mr. E. M. Anderson made important contributions, that the dykes were formed after the sheets destroyed the basis of the theory. It is true that the Memoir refers (p. 99) to 'the possible co-operation of normal fissure-eruptions in building up the lava-pile of Mull.' But this co-operation would have been limited to building up a hypothetical super-structure of which there is no existing remnant.

"Mull as it exists seems to me to give no support to the fissure eruption hypothesis."

# The Return of the Bison.

**By M. Steedman.**

*During the past six years the Canadian Government has been liberating the bison from the National preserves, to which the animals had since 1906 been confined to avoid extermination. In 1928 two thousand bison were transported by rail and steamer to the Great Slave Lake region, and trade in hides is already reviving.*

THE Monarch of the Plains is returning to his kingdom in Canada. For many years he has been virtually a prisoner, for though he has had considerable freedom in the National Parks, nevertheless a fence has surrounded his stamping grounds; now he is once more free to roam the northlands of the Dominion. The past twenty years have been eventful ones in the history of the bison. The story of how they roamed the plains in tens of thousands when white men first visited Canada, and of their reckless extermination owing to the greed of hunters, has been told frequently and well. But how this interesting native species has been restored and the herds increased in numbers is a fascinating romance of which the world has heard little.

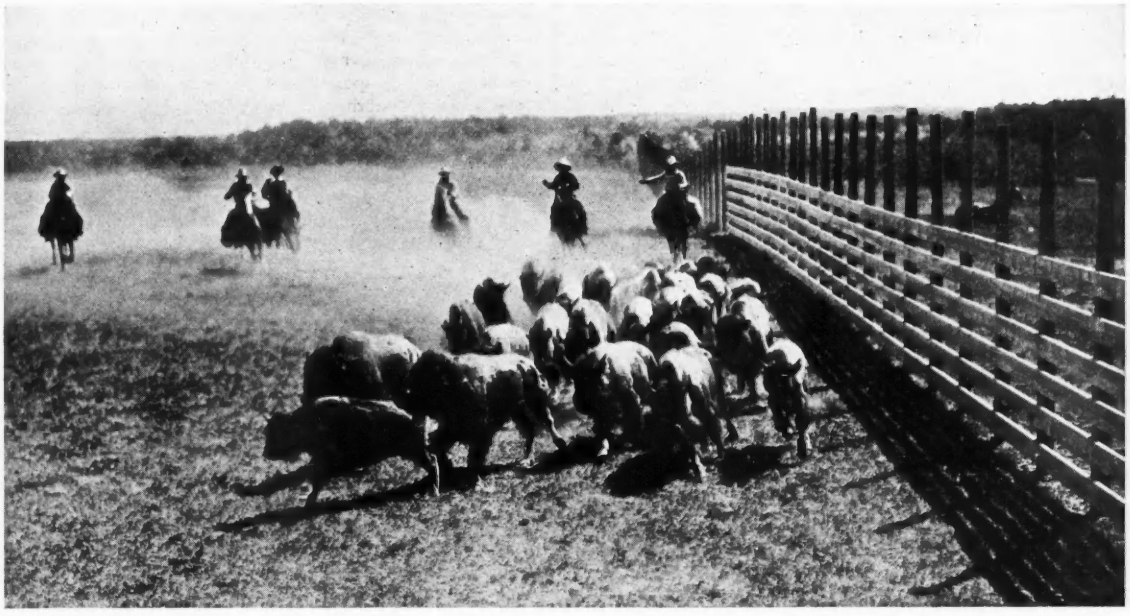
Forty years ago the only buffalo—to give them the name commonly though incorrectly used—left in Canada were a small herd of a woodland species near the Arctic Circle. However, in 1906 a Mexican half-breed named Michel Pablo offered to sell a herd of 716 animals to the Canadian Government. Pablo was the owner of the last wild herd in the United States, and the Canadian Government very wisely decided to purchase the animals at 250 dollars per head. The herd was in Montana and had to be rounded up and transported to Canada, by no means an easy matter. A buffalo can run faster than a horse, so that expert riders are required to carry out the thrilling and dangerous work of rounding up the beasts. The timber of the fencing surrounding the corral into which buffalo are to be driven must be one foot thick or they will break through.

GROUP IN BUFFALO NATIONAL PARK.

In spite of their comparative freedom, the bison in the National Parks are subject to restriction which the new herds will no longer experience.

In 1907 three hundred buffalo, nearly all cows and young stock, were taken to Canada and placed in Elk Island Park. The following year, after a terrible round-up, about three hundred were driven into a corral on the bank of a river to await transportation. A wily cow found a way of escape and, acting as leader, swam across the river and clambered up a narrow track in the clay cliffs on the opposite bank. When the men arrived in the morning to put the animals in the train the corral was empty. It had not been thought necessary to leave a guard because of the position of the corral. That year no buffalo arrived in Canada.

In 1909, having gained experience from the ill-luck of the preceding year, those responsible constructed large pens mounted on wheels, which could be driven thirty miles to the railway station. The animals were rounded up into strong corrals, this time watched by armed guards. The people of the United States had now wakened up to the fact that their last wild herd of buffalo was leaving the country, so some of them made very determined efforts to prevent them leaving, hence the armed guards. The following day the animals were driven into the prepared pens and placed on the train. At the Canadian end a reserve of 160 square miles extent, strongly fenced, was prepared for their reception. A laneway one mile long led from the railway siding to the park. It was thought that there might be a great deal of trouble when the buffalo left the train, but the leader, as soon as the car door was opened, threw up his head and then set off at a brisk trot down the runway, followed by the rest of the herd, eager to taste the rich grass. In its new surroundings the bison continued to thrive and increase. Since 1909 the total increase over



A ROUND-UP OF BISON PRIOR TO TRANSPORTATION.

the original herd has been 14,301. There has, of course, been a loss through natural causes of more than one thousand but, as might be expected, the numbers have gradually become too many for the park to support.

Starting in 1922, it was therefore decided to convey some of the young stock to the north and set them at liberty, and an increasing number has been sent each year. In 1928 two round-ups were held. In the preceding autumn the wardens had " cut out " 1,100 yearling calves and driven them through a system of corrals, from which they could be separated at will. These were kept in a special enclosure during the winter and fed until in good condition. Early in April the usual spring round-up took place, and 800 more young animals were cut out and corralled. The first specially constructed express buffalo train left Wainwright for the north on 6th June, that being the earliest date the weather permitted. Every week during the summer the buffalo train ran until nearly 2,000 animals had travelled to the end of the railway at Waterways. Here the beasts have to be transferred to scows made for the purpose and are conveyed down the Athabasca and Slave Rivers to the Great Slave Lake region. The scows are equipped with big, strong pens. The buffalo are set free to wander at will and to pick up their living as in olden days. They will no doubt come in contact with some of the larger woodland species that are wild and somewhat different. How they will thrive under these natural conditions and what will be the result of the mixing of the two species it is impossible yet to say. Altogether over five thousand animals have been liberated.

Recently a contract was made with a Calgary Packing Company for the slaughter of one thousand animals, and from the meat and hides a reasonable profit was obtained. The generation that was familiar with buffalo products has largely passed away, but when the beauty and durability of a buffalo robe as a floor covering or a motor rug is realized, there will no doubt be a demand exceeding the supply. Three superb buffalo robes mounted as floor rugs were presented to the Prince of Wales and Prince George and to Mr. Baldwin as souvenirs of their Canadian visit. A few buffalo have been sent to various parts of the world for exhibition or scientific purposes, and amongst these were two females sent to Edinburgh.

Cross breeding experiments resulting in the production of a new variety called the Cattalo are very interesting. A buffalo is first crossed with a yak, then the offspring is crossed with ordinary domestic cattle. The calves representing various percentages of buffalo, yak and domestic cattle are promising looking animals. What use will be made of these hybrids it is too early to say, but it is hoped that they will prove of commercial value.

# Book Reviews.

*The Plant in Relation to Water: a study of the physiological basis of drought resistance.* By N. A. MAXIMOV, Professor in the Institute of Applied Botany, Leningrad. Translated and edited by R. H. YAPP. (Allen & Unwin. *21s.*).

**Reviewed by Professor A. G. Tansley, F.R.S.**

The tissues of an ordinary land plant—herb or tree—may be likened to a saturated sponge with most of its surface exposed to the air, to which it is continually losing water by evaporation, while one end is buried in moist soil from which it continually absorbs water with which to supply this loss. The rate of absorption is, however, limited, and it is clear that the "sponge" would dry up if there were no means of checking the rate of evaporation from the exposed surface. The primary means by which evaporation is checked is the continuous *cuticle*, composed of a mixture of substances allied to fats, which covers the surface of the stem and leaves. But a plant cannot completely shut off its tissues from the air by a gas-tight barrier, because it depends on the air for the carbon dioxide supplying the carbon required to build up its tissues and for the oxygen necessary for respiration, while the process of evaporation of water itself serves more than one useful purpose; and this could not continue freely unless there were a means of escape for the vapour evaporated from the living cells of the leaf into the air spaces surrounding them. Provision for gaseous exchange between the interior of the leaf and the surrounding air is secured by means of pores—the so-called *stomata*—penetrating the cuticle. The *stomata* are not, however, permanently open, but are able to open and close by means of variations in the turgidity of the pair of *guard cells* which surround each stoma. At one time it was thought that the turgidity of the guard cells increased, opening the pore, when there was plenty of water in the leaf, so that *transpiration* (the process of loss of water vapour from the leaf to the air) could proceed safely, while when water was deficient the guard cells became flaccid and closed the pore, thus checking the loss of water. It has, however, been known for many years that factors other than abundance or scarcity of water are really responsible for the opening and closing of the guard cells, and that this process cannot therefore be regarded as a mechanism for regulating the loss of water by evaporation from the leaf.

Plants growing in situations where they can obtain very little water from the soil, for example in climates where the rainfall is extremely scanty, have to meet a situation in which the loss of water by evaporation would be far greater than the supply that could be absorbed from the soil if their structure and general water economy were the same as that of plants living in wet or medium climates where they can always obtain sufficient water. Such plants—*xerophytes*, as they are called—have adopted various means of existing under the dry conditions. One of these is the reduction of transpiration by the obstruction of the diffusion of water vapour through the stomata from the living cells to the outside air, and the structural peculiarities on which this obstruction depends are frequently described in elementary text-books as if they were characteristics of xerophytes generally. Professor Maximov shows that this is by no means the case. Many xerophytes, on the contrary, have no such obstructions to free transpiration, and actually transpire more copiously than ordinary plants *when a sufficient water supply is available.* By means of a very richly branched, or a very deeply penetrating, root system, some of them are able to tap a very large bulk, or very deep-lying layers, of soil and thus to cover their water loss. Others again—the succulents—store large quantities of water which they have absorbed during the short rainy season, and lose it by evaporation very slowly indeed. Yet others actually lose most of their water during the dry season and remain in a state of suspended animation till the rains come again—they are able, in fact, to endure loss of water to a degree far beyond that which would kill an ordinary plant.

The great merit of Professor Maximov's book is his critical discussion of all the different means of resisting drought, largely based on his own experiments in the arid regions of south-east Russia as well as at Leningrad. The worth of the book is much enhanced by the extreme care which the English editor—the late Professor Yapp, whose early and tragic death all botanists lament—has devoted to his task, adding numerous explanatory footnotes of great value. The book, which is presented in fluent and excellent English and has a very full list of literature, is indeed far in advance of any previous presentation and will be of the greatest use to all students, teachers and investigators of this fascinating subject, the thorough study of which is of the first importance, not only to botanists, but to scientific agriculturists concerned with the production of drought-resistant crops.

*Soap Films: A Study of Molecular Individuality.* By A. S. C. LAWRENCE. (G. Bell & Sons. *12s. 6d.*).

This book is based on the experimental work of Sir James Dewar. Not everyone has heard of this scientist, but everyone has used one of his inventions, namely, the Thermos flask. Most people outside of the world of science know about him through Mr. Bentley's lines :—

> "Sir James Dewar
> Is a better man than you are.
> None of you asses
> Can condense gases."

The scientific world knew him as professor at Cambridge and at the Royal Institution in Albemarle Street where he was the true successor of Davy and Faraday. Like these great and almost legendary figures, he was a marvellous experimenter. Indeed, although it is high praise to say so, he was the greatest man in the second half of the nineteenth century in his ability in devising and carrying out beautiful experiments. In time also he may become a legendary figure. Who can ever forget a visit to his laboratory to see the experiments he had in progress, or to admire his experimental devices, or to visit his house at the top of the Royal Institution to enjoy the Scottish "hospitality," the racy talk, the pawky comments and the torrent of denunciation. No one who heard a lecture by Dewar can forget the beauty and simplicity of his experiments when they went right, or forget his comments when they went wrong.

The author of this book was for many years assistant to Dewar at the Royal Institution, and being himself a good experimenter and a careful and interested observer, he acquired a remarkable knowledge of the technique used by Dewar in his researches on the properties of soap films. He has been encouraged to put his practically acquired knowledge on record, and this he has done. Readers of Professor C. V. Boys' book on "Soap Bubbles" should obtain this book. It gives an excellent and informed account of soap films in both their theoretical and practical aspects from a point of view different from that of Boys' work. The book is for the student rather than for the ordinary reader. It demands a knowledge of chemistry and of the properties of matter which only students of natural

science ordinarily hold in their heads; nevertheless the book is written without pedantry, and redeemed from dulness by excellent illustrations and touches of humour. *Per contra* it is informed and well documented. It is abundantly evident that the author has been writing it for some time and has laboured to make it as accurate as possible. Indeed, in his endeavour to be brief, accurate and up to date, he has almost overdone matters; some of the foot-notes are overloaded, and read like irrelevant ejaculations, though the statements they contain are undeniably true.

Chapter one deals with surface tension, a subject which is a necessary introduction to an account of soap films. Chapters two and three give an account of soap, saponaceous materials in general, and the production of films from them. The fourth chapter deals with the interesting subject of the black film, especially with regard to its thickness. Later chapters deal with soap solutions generally, with the properties of actual molecules of soap and with the composition and structure of the soap film. There are sixteen plates, mostly reproduced from the papers of Sir James Dewar, and they admirably illustrate the statements and discussions in the text. No one who has read this book can fail to be interested in a subject or a group of subjects on which a great deal of experimental work has been done, but on which the last words have yet to be said.

A. S. RUSSELL.

*On Alexander's Track to the Indus.* By SIR AUREL STEIN, K.C.I.E. (Macmillan. 21s.).

Alexander's achievements in the wild hill-country beyond the north-west frontier must always rank as the most astonishing military operations in history. The vision of his disciplined troops, accompanied by siege engines and by every artifice of war that a superb leader could devise, pressing inexorably up the remotest valleys of Afghanistan and the Swat and Indus valleys is one which has remained in the mind of all who have read of his exploits. Yet, strangely enough, only a fraction of his journey has ever been fixed for certain by accurate exploration and some of his most astonishing feats have remained illuminated only by the ancient authors who described them. Sir Aurel Stein, however, the most indefatigable of modern explorers, has at last shown us the realities of one of the most extraordinary exploits of the Macedonian. He is the first European to set foot on the fortresses that Alexander stormed in the Swat valley and at last to fix beyond cavil the site of the mighty rock of Aornos, the capture of which was Alexander's most brilliant achievement in the Indus valley.

Sir Aurel Stein's narrative partakes of the nature of drama. He is given, after thirty years of waiting, a chance to enter the Swat valley and to penetrate over the watershed that divides it from the Indus valley. A powerful and friendly prince of this independent region, now held by the wildest of Pathan tribes, welcomes him and affords him the full protection of an established ruler. Sir Aurel moves from the ruler's capital northwards up the wild Swat valley to its headwaters, then retraces his steps a little and crosses the divide to the Indus valley over a pass 8,000 feet high. As he leaves the British zone and moves up the valley the drama begins. He first fixes on two sites, known as Bir-Kot and Udegram, and satisfies us and himself by philological, archaeological and topographical evidence that the former is the city called by Arrian Bazira and the latter Ōra. We have at last got on to the tracks of the conqueror. As the narrative proceeds we see how Alexander had pressed up the Swat valley from the Punjab to clear it of its inhabitants, the warlike Assakenoi. With Sir Aurel we then follow the Assakenoi refugees over the watershed to the rock-refuge of Aornos, where they concentrated in great force. Alexander had meantime returned southwards to the plains to rejoin his main force. He then turned northwards again, but this time up the Indus valley from the city of Embolima, which Sir Aurel accepts, but without certainty, as the modern Amb. With Sir Aurel we can watch his approach from the point of view of the Assakenoi assembled in what they thought was an impregnable fortress. The identity of Aornos with the ridge of Pir-Sar is as certain as any identification can be which is not confirmed absolutely by excavation. Even so, Sir Aurel finds the ruins of a very ancient fort on Pir-Sar which may possibly be that hastily erected by Alexander's soldiers after the capture, as we are told in the ancient texts.

The reading of this book is an excitement and a delight. We seem to share the author's enthusiasm, and almost his pleasures and his hardships. Perfect photographs illustrate the course of the journey from start to finish, and with a small scale and a large scale map to guide us we can see every difficulty and almost feel the grandeur of the mountain scenery.

The identification of Aornos in particular is a model of what good topographical research in ancient history should be. The author first reads his sources and traces the general strategy of Alexander. The Swat valley had been cleared and subdued, but the general could not proceed upon his further plans in India as long as a large body of savage tribesmen were congregated in a fortress on his flank. He therefore proceeds directly against their position. Once granted the return from the Swat valley southwards and the concentration for the move up the Indus valley, which is not disputed, the site of Aornos must lie up the Indus valley only a few marches. Fortunately we are given fairly precise details about the site of Arrian, Curtius and Diodorus. We are told its approximate height, and circumference, and are given a graphic description of it as "ascended by a single path, supplied with natural sources of water and covered with some considerable space of arable ground." The explorer has come across to the Indus valley along the route always used from time immemorial by those who move from the Swat to the Indus. He has, therefore, availed himself of the best geographical and traditional evidence. On reaching the Indus valley he sees at once that there is no site below Pir-Sar which corresponds to the description of Aornos, and satisfies himself that there is not likely to be anything farther up the Indus that might be more suitable. By a process of elimination Pir-Sar is probably the site. There remains the argument from a strict survey. This done, the site is found to correspond almost exactly in dimensions with the site described by the ancient historians. Sir Aurel then proceeds to reconstruct the dispositions of Alexander, the siege and the capture, and we follow him on the large scale map. The whole reconstruction is convincing and methodical. This is the climax to the drama, and rightly kept for the close of the narrative.

Sir Aurel has a disarming modesty and pleasant mannerisms. He tells us how he has an "imperfect command of Pushtu," remarks without emphasis "It was delightful to feel that I was moving between mountains on which no European eye had hitherto rested, at least not since classical times," and, like a sound archaeologist, he never forgets to notice and photograph the various "relievos" of the Buddhist and other periods that come his way. The Swat region has, for him, and indeed for his readers as well, a notable charm, because it was known

as Udyana, "The Garden," and had been for centuries a region peculiarly frequented by Buddhist monks and Chinese and other Pilgrims. Its loveliness is as great as its interest, and Sir Aurel shows us many a Stupa that once held some relic of Buddha, and even one of Buddha's footprints on a stone and the sacred rock where he washed his clothes. Moslem fanaticism has left all too little of these ancient Buddhist landmarks, but what survives is here faithfully recorded.

We learn one thing with a certain surprise. The author invariably enquired for any legend or folk tradition that might have survived in a region where Alexander's exploits had so amazed the world. If found, such legends may often serve as useful confirmatory evidence. But both in the case of the two sites in the Swat valley and at Aornos, there was nothing of any kind. His "repeated careful enquiries among local Pathans, Gujars and Mullahs" did not reveal "the slightest indication that folk-lore or quasi-learned tradition in this region in any way connected Swat and the adjacent hill-tracts with the exploits of Sikander." This, if disappointing, is important to know. Alexander is a name so well known still in Turkestan, Afghanistan, and northern India, that it occasions no little surprise to hear that the valleys and hills through which his glittering columns passed triumphantly have now lost all memory of him. We can the more distrust the other legends so sedulously handed down about him in the Middle East. Perhaps after all the village schoolmaster is their chief inspiration.

The maps in this notable book are a little confusing in their use of place-names which vary in spelling from the versions in the text. Thus Shilkai in the text is Shalka on the map, Kana is Kuz Kana, Hazara is Chagarzai, Nūrdai is Nūrdi, and Achar is Acharo Sar. One slip only was noted, namely the height 6,741 referred to on page 144 is given on the map as 6,471. Such differences make the maps a little difficult to follow. But these are trifling criticisms. The book is the record of a most remarkable achievement and a contribution to scholarship of the first order. S. C.

*A Mechanical Method for Solving Problems of Flow in Compressible Fluids.* By G. I. TAYLOR, F.R.S. and C. F. SHARMAN, PhD. (H.M. Stationery Office. 1s.).

As readers of Mr. Owen's article in *Discovery* for June will remember, the chief study of aerodynamical laboratories at the present time is concerned with the steady flow of air past solid bodies, at speeds which are so low that the effect of compressibility is inappreciable. In recent years, however, the rapid increase in the speed of aircraft has much increased the importance of the study of the effect of compressibility on air flow. As an example, the tips of the propellers of high speed machines may move at speeds as high as one and a third times the speed of sound.

In the present report, first published by the Royal Society, a method is described by which it is possible, without very great labour, to find the flow of a compressible fluid past an obstacle of any shape provided that irrotational motion is possible. The first application of this method has been to Rayleigh's case of the circular cylinder. In this case the method produces, mechanically, successive approximations practically identical with those which would result from successive applications of Rayleigh's mathematical method. One of the most important results of the present work is the discovery that the failure of convergence occurs not when the speed of the main body of the stream reaches that of sound but at some lower speed. In the case of a circular cylinder, convergence fails when the maximum velocity in the field reaches the speed of sound in the air at that point. This first occurs when the speed of the stream is between four-tenths and one half of that of sound. At the second of these speeds it appears that no continuous irrotational motion is possible past a circular cylinder.

The method is dependent on an electrical analogy with the equations of hydrodynamic flow and uses a tank the depth of the electrolyte in which can be varied. An alternating current is passed between the model and the sides of the tank. Successive approximations to the form of the bottom of the tank gives values of the density.

*Railways of To-day.* By CECIL J. ALLEN, M.Inst.T., A.I.Low.E. (Frederic Warne. 12s. 6d.).

Mr. Allen is well qualified to write a book of this kind, as he has been a regular contributor to the *Railway Magazine* for twenty years. His treatment of the subject in all its ramifications is broad and lucid. He does not confine his attention to Great Britain, but deals with foreign and Dominion railways, and especially with those of France and the United States.

The book is divided into four logical sections—the track (including railway history and some famous engineering feats), the motive power (explaining the whys and wherefores of locomotive design and discussing electric traction), the trains (describing the coaching stock, famous expresses, and suburban services), and railway operation (dealing with signals, stations and administration). There are eleven full appendices, giving particulars of important engineering feats, longest runs, railway summits, etc., and copious cross-references to the text. A feature of the book is the illustrations. There are thirty-six coloured plates, of which many are two-paged, as well as 200 half-tone photographic plates, twenty-five line diagrams and one complete four-page sectional chart of an express locomotive. All are of material value in elucidating the text. The jacket bears a reproduction of an L.N.E.R. steam rail-car of at first sight rather puzzling aspect, and an L.N.E.R. engine is embossed on the binding. But altogether Mr. Allen, with the help of the illustrations, has succeeded admirably in his purpose. This is as good a railway book of a popular kind as the reader can hope to see.

*On the Bottom. An Epic of Deep Sea Diving.* By COMMANDER EDWARD ELLSBERG. (Constable. 10s.).

This book tells the story of one of the finest achievements in the history of salvage by diving. When the United States submarine S. 51 was rammed by the *S.S. City of Rome* on September 25th, 1925, and sent to the bottom with a gaping hole in her side, the most experienced salvage experts openly derided the possibility of ever bringing her to the surface again. She lay at a depth of 132 feet, fifteen miles from land, in one of the stormiest sectors of the north American coast, where on the calmest day a more or less heavy ocean swell is liable to be encountered. In the best conditions of weather, diving at this great depth is attended with danger and difficulty, and the conditions faced by Commander Ellsberg and his men were of the worst. The officer who was in charge of the work from beginning to end writes with simple directness in this interesting book, which is edited with an introduction by Mr. H. C. Bywater.